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[OFFICIAL NOTICE.]

New England Association of Gas Engineers.

SECRETARY'S OFFICE, BIRMINGHAM, CONN., Jan. 30, 1890.

The Twentieth Annual Meeting of the New England Association of Gas Engineers will be held at Young's Hotel, Boston, on Wednesday and Thursday, Feb. 19th and 20th. The meeting will be called to order by the President, Mr. Robert B. Taber, on the 19th inst., at 10 o'clock A.M. It can now be definitely stated that the following papers will be read sometime during the meeting:

"Vaporization and Feed of Oil to Generator or Retort," by Dr. Robt. Amory, of Brookline, Mass.

"Management of Small Gas and Electric Light Plant," by S. J. Fowler, of Westfield, Mass.

"A Point or Two in Regard to Illuminants During Condensation and Purification," by George F. Goodno, of Dedham, Mass.

"Notes on Revivification of Oxide," by Waldo A. Learned, of Newton, Mass.

"Various Methods of Introducing Gas Stoves," by H. A. Norton, of Boston, Mass.

"A Few of the Advantages of Water Gas over Coal Gas for Small Works," by F. H. Parker, of Burlington, Vt.

"The Difference between Eastern and Western Methods in the Management of Gas Works," by E. G. Pratt, of Des Moines, Iowa.

"Why I Shall Make Water Gas," by A. B. Slater, of Providence, R. I.

"A Chapter of Don'ts," by W. H. Snow, of Holyoke, Mass.

"Some Notes Taken in a Small Gas Works," by Ralph Woodward, of Waltham, Mass.

"Problems Constantly before the Gas Manager," by E. H. Yorke, of Brockton, Mass.

In addition to the above there are partially promised several other papers. I think all the members who see this notice will agree that, judging by the above list, the coming meeting bids fair to be a greater success than any of the meetings which have been held in previous years. The topics are quite varied, and many of the subjects are among the most important that gas managers have to deal with at the present time.

The officers of the Association believe that no member of the Association, and no one connected with the active business management of any gas company in New England, can afford to be absent from this meeting. Persons eligible for membership and desiring to join the Association will please apply at once to the Secretary, who will forward them blank applications. Although the membership is large, there are still a good many persons connected with the gas business through New England who do not belong to the Association. It is hoped that all such persons will see fit to join at the coming meeting, and make the Association what it ought to be, truly representative of the gas interest in the New England States.

Invitations have been received to visit the Commercial Point and Bay State gas works in Boston, also the Loomis Fuel Gas plant at Waltham, which will add materially to the pleasure of the coming meeting.

CHARLES H. NETTLETON, Sec'y.

[OFFICIAL NOTICE.]

Ohio Gas Light Association.

OFFICE OF SECRETARY,
COLUMBUS, O., January 20, 1890.

To Members of the Ohio Gas Light Association:

Gentlemen—The Sixth Annual Meeting of this Association will be held at Toledo, O., on March 19 and 20, 1890.

This announcement is made thus early in order that all members may be reminded of the meeting in ample time to make their arrangements to be present. Every member is urged not only to attend this meeting, but also to interest himself in inducing others of his acquaintance who are eligible for membership, but who have not as yet joined the Association, to come to the meeting and become members.

It is not intended that as many papers as usual shall be presented at the forthcoming meeting, in order that more time than formerly may be had for the discussion of those that are read, and for such other matters and business as the members may desire to dwell upon.

Although the Secretary has for some time been engaged in the work

of soliciting papers for this meeting, he has not yet secured as many as should be had, notwithstanding fewer are desired than heretofore, and he therefore earnestly calls upon all members who can possibly do so to notify him immediately of their willingness to furnish papers.

It has been decided that an interesting and valuable feature of our meeting would be a "Question Box," in which members can place questions, which will be withdrawn and read to the meeting and answered and discussed by the members. Every member is requested to send to the Secretary at once any question or questions which he would like to have thus brought before the meeting.

Future circulars will announce further details concerning the meeting.

Respectfully, IRVIN BUTTERWORTH, Sec'y.

BRIEFLY TOLD.

THE NEW ENGLAND'S TWENTIETH ANNUAL.—In less than a fortnight the members of the New England Association shall have completed their twentieth annual reunion, and he might securely look for pardon who would exclaim that it did not seem as if 20 years had winged their flight from us into the silence of the past since the formation of the Association. Time, however, with even tread and careless of opinion, goes on untiringly. Take it all-in-all, the Association has much to congratulate itself in that time has dealt sparingly with its membership. Of course, it is said, and wisely, that exceptions serve to best prove a rule, and the assertion that time has dealt sparingly with the "Mother Association" can be proved by the record, even though the last exception is furnished in the death last month of Oliver Edwards Cushing, who served on the Board of Directors chosen at the first meeting in Boston, on Feb. 2, 1871. Changes there have been, and many, of course—Greenough, Sr., Hill, of Concord, Armington and Cabot relieved of active service; Cushing and Dwight dead—in fact of the first executives chosen those who still remain in harness are Neal, York and Moore, of Salem. Sturdy and strong and staunch as were the habits and morals of those who founded it, so has the Association progressed with the increase in its years of life and usefulness; and if we may judge from the matter which its Secretary, Mr. Nettleton, has been placing before our readers in the shape of current official notices it is bound to even make better history for itself than that in record of the past. A glance over the paper list will likely cause every member to make successful effort to be present when President Taber sounds the call to order, in order that its promise may be fully availed of. Many of the papers are to be by contributors who have not yet figured on the paper lists, and this of itself is convincing proof of the solidity of the Association. When each is willing to do his duty, the advancement of the common good is assured. In looking over the schedule one cannot but be impressed with the variety of subjects named, and the exceeding value to the fraternity that will arise from their presentation. Two papers in particular we look forward to with great interest, and while it may be as rash to attempt to justify a paper by its title as we are told it is to judge a book by its cover, we nevertheless hold that the contributions to be made by Mr. Goodno, of Dedham, and Mr. Pratt, of Des Moines, have been artfully named, that is, in respect to the facility of their titles for giving rise to anticipation. Aside from the regular list so far collated, it will be noted that Secretary Nettleton has the partial promise of other papers, but even should these fail to materialize the catalogue is sufficiently lengthy to insure plenty of thought food. We would urge upon those qualified to become members of the Association the advantage of so doing; and it goes without saying that the expense connected with the membership is sure to be more than one hundred times counterbalanced in the return that will be received.

DEATH OF DR. LULL, PRESIDENT OF THE DUBUQUE (IOWA) KEY CITY GAS COMPANY.—The fraternity, more particularly those engaged in the West, will join with us in regret over the death of Dr. John H. Lull (President of the Key City Gas Company), which sad event occurred on the morning of Wednesday, January 22d. Deceased had been complaining for some days, but did not attach any great importance to his symptoms. The latter, however, eventuated in an attack of pneumonia, which terminated fatally and with shocking suddenness. John H. Lull was born at Hartland, Vt., in June, 1828, and graduated from the Vermont Medical College, in the spring of 1850, as a duly qualified physician. Having looked the home field over carefully, he determined that preferment would come more quickly in a somewhat more extended field, and accordingly visited the West. In the fall of 1853 he settled in Dubuque, Iowa, in which city was spent the remainder of his busy life. No more devoted or capable citizen was sheltered by that city, and to its material advancement he gave freely of time, counsel and money. Preferring the greater latitude offered by commerce, deceased did not practice his profession in Dubuque, but turned his attention to business and its responsibilities. To name any of the important local enterprises started within the last 30 years is almost to mention an instance of Dr. Lull's connection with the material interests of Dubuque. Banks, manufacturing companies, public works—all claimed a share of his patronage and counsel. He was President of the Key City Gas Company for many years, and was a firm believer in the stability of gas lighting—a belief that largely added to his store of wealth. Respecting the personal character of the deceased, we are favored with the following from a correspondent:

"He was a man of remarkable breadth of mind and keen penetration. His executive ability was unusual, and it is a simple statement of fact to say that but for his foresight, optimism and energy many of the enterprises of which Dubuque boasts to-day, and which have greatly increased its population and enhanced its wealth, would not have materialized. He amassed means by prudence, and he so employed them as to make them a source of maintenance and blessing to others as well as to himself. No man could have devoted riches to a better use, and no man ever acquired them more justly. Dr. Lull was a diligent reader and profound thinker. His general knowledge was copious, and on certain historical, political and scientific subjects his knowledge of detail was astonishing. Endowed with strong reasoning powers, he drew sound conclusions, and conversation was with him a delight. It was impossible to exchange thoughts with him without being entertained and edified by his discourse. He had a catholic mind. It was expansive and well balanced, and a stranger to bigotry and prejudice; and like his mind, his heart was generous. No religious denomination ever appealed to him in behalf of charity in vain, and the deserving mendicant never left him empty-handed. He took pleasure in placing meritorious persons in the way of business success. His life was useful and honorable, and the loss of it is a loss to the community. To his family his demise is an almost insupportable affliction, but such poor consolation as heartfelt public sympathy can give them is theirs."

CHEAPER GAS FOR PEORIA, ILLS.—Almost every Western gas man is acquainted with Mr. Peter Coffey, Superintendent of the Peoria (Ills.) Gas Light and Coke Company, whose genial personality makes him welcome at all times. The Peoria man, however, is more than genial, in that he stands for what is "known out that way" as a "hustler." For many years he has been in charge of the manufacturing and distributing plants of the Peoria Company, and his command thereof has not been in vain. When to Coffey's ability and tact is coupled the fact that the executive management of the Company is of the progressive sort, one would naturally expect to hear that cheap gas is the rule at Peoria, nor would that presumption be wrongly held. Liberal as the former rates have been, the Superintendent has convinced his Directors that another cut could be made without prejudice in their business. In any event, an announcement has just been made that from and after the 1st prox. the following net rates are to prevail:

Monthly Consumption.	Net per M.
Less than 30,000 cubic feet	$1.35
30,000 cubic feet and over	1.20
Gas for stove and power purposes	1.00

The only condition for obtaining a gas supply on the basis noted is that bills shall be paid on or before the 10th of the month. The figures speak most eloquently for Supt. Coffey's capability and his Company's tact, and while we are always on the lookout for opportunities of this kind as evidence of the advance that is being made in gas manufacture, we must admit that we were hardly prepared to announce that the next city to enjoy the dollar gas rate would be Peoria. Facts accomplished are those that lead to greater things, and it is in records of this nature that not only the stability but the continued triumph of the gas maker's craft can be proclaimed.

THE opposition to the reappointment of Mr. Rowell as a member of the Massachusetts Board of Gas and Electric Light Commissioners—his term of office expires within a few months—seems to be confined to a clique whose "practical politics" have hitherto been looked on with little favor by those who consider fitness for public service as the best recommendation that an aspirant for public office can present in support of his claim for recognition. While fully believing that Mr. Rowell's chances for reappointment are of the strongest sort, we nevertheless consider it our duty to say that it would be poor reward for faithfulness and fidelity did he fail of reappointment. His course in the Board, in common with that of his colleagues, has been of a nature well qualified to evoke admiration for its candor, impartiality and value.

MR. H. BOSTWICK has filed papers in the District Court (Hastings, Neb.) in which he prays for the appointment of a receiver for the Hastings Gas Light Company; also that the charter of the Company be revoked.

SOME days ago one of the Dominion Gas Inspectors paid a visit to the works of the Windsor (Ont.) Gas Company for the purpose of testing the purity of the gas supplied. He found an excess of sulphureted hydrogen, and complained of the same to Judge Bartlett, who summoned Manager Nash, of the Company, for an explanation. The latter having admitted that the Inspector was in the right, was fined $12.85 under the statute.

Note on Rankine's Treatment of Chimney Draft.

By Prof. J. Burkitt Webb.

Prof. Webb, in the last issue of the *Stevens Indicator*, having explained that his attention had been called to a criticism of Rankine and other noted authors, in a paper before the American Society of Mechanical Engineers, by Mr. Gale, in the discussion of which it was stated that a correct solution of the problem, if not two, is contained in "La Chaleur," by Peclet, remarks that on examination it appears that the paper is based upon an incorrect hypothesis, and that the only solution in "La Chaleur," which is claimed therein to be correct, gives the same result as does Rankine.

A brief comparison of the solutions will illustrate a point or two in mechanics and show Rankine's deep mechanical insight.

In Peclet's solution the pressure operating to produce the draft is found by subtracting the weight of a column of hot air, the height of the chimney, from that of an equal column of cold air.

The height of a column of air, which will give the pressure, is then calculated and the velocity reckoned as due to this height, in the same manner as the velocity of water issuing from a vessel is deduced from its height therein.

But Peclet hesitated between representing that pressure by a column of cold air and supposing it to produce the velocity with which the (cold) air enters the chimney, and representing it by a column of hot air, producing the velocity of the (hot) air issuing from the top of the same.

Mr. Hudelo, editing the last edition of Peclet, says that the mechanical theory of heat furnishes the means of deciding between the two formulas, and his analysis leads him to the choice of the column of hot air; the principles of thermodynamics, however, are not needed to show which formula should be used, the principles of mechanics known to Peclet being sufficient.

If the velocity be calculated by means of the column of cold air the total pressure available to produce the draft will be appropriated to the production of the velocity of the entering (cold) air, and nothing will remain to cause the increase of velocity which must accompany the increase of volume, when the air is heated by the fire.

Evidently the pressure at disposal should be supposed to be occupied in causing the final velocity of the (hot) air issuing from the top of the chimney, unless the fire can be supposed responsible for the increase of velocity as well as the increase of volume.

Now, it is a principle of mechanics that the internal forces in a free body or system of bodies cannot affect the motion of the center of gravity of the same, and, therefore, when an elementary mass of air is heated by its internal expansive forces, acting equally in all directions, can have no effect upon the velocity of the mass, which is controlled entirely by external forces.

While it is true that the fire is responsible for the increase of velocity, and, indeed, for the whole velocity, it causes it in an indirect manner; in fact, the fire simply keeps the clock wound up, so to speak, leaving it to run down under the control of gravity alone.

In refreshing contrast to the analysis in the last edition of Peclet, with its thermodynamic mistiness and approximations, is the clear and simple treatment in Rankine's "Steam Engine," some pages before thermodynamics is reached. While Peclet is referred to, the analysis is given in Rankine's own way. The question of head is disposed of in the following words:

"The formula* enables the velocity u to be computed when the head h is given;.....

"The head h is expressed in feet in height of a column of the hot gas in the chimney.

"The head may be produced in three ways:

I. By the draft of a chimney.

II. By a blast pipe.

III. By a fan or other blowing machine.

"I. The head produced by the draft of a chimney is equivalent to the excess of the weight of a vertical column of cool air outside the chimney, and of the same height, above that of a vertical column, of equal base, of the hot gas within the chimney; and, when expressed in feet of hot gas, it is found by computing the weight of a column of the cool external air as high as the top of the chimney is above the grate and one foot square in the base, dividing by the weight of a cubic foot of the hot gas, for the height of an equivalent column of hot gas, and subtracting the former height from the latter."

Fig. 1 illustrates Rankine's conception. $C\,D$ is the chimney whose draft is to be found. $D\,E$ is a supposed extension of such height that the column of hot gas $E\,C$ exerts the same pressure per square foot as the column of cold air $A\,B$.

If the outlet at F is closed the column of hot gas balances statically that of cold air, but if F is open the hot gas flows out under the head $E\,D$; and if air is supplied at A the flow will be from A to F.

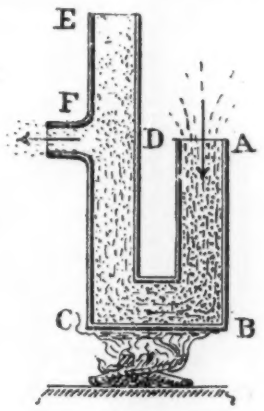


Fig. 1.

As the atmospheric pressure is the same at A and F it can be omitted entirely from the problem.

Peclet starts with the supposition of a fire outside to warm the air passing from B to C, so that the chimney contains air alone; Rankine supposes hot gas in the chimney, but his analysis applies equally to hot air.

A model could be made to illustrate this action in a tube of the same form, $A\,B\,C\,D\,E$. Let water be supplied at A, and let a jet of air be blown in at right angles to the current between B and C with sufficient force to mix thoroughly with the water. In $A\,B$ there will now be solid water, and in $C\,E$ a lighter mixture of water and air, which will rise to a height $D\,E$ above the water level at A, when the mixture is properly proportioned, so that the issuing velocity at F will be that due to the head $D\,E$.

Thermodynamics may, however, be legitimately brought into the problem, for it must be evident that the density of the hot gas will not be the same at all parts of the chimney, and to get at the weight of the column some average density must be assumed, or the law of its variation must be obtained upon thermodynamic principles. The former method is, however, sufficiently accurate for all purposes.

Rankine knew that thermodynamics was not needed in the problem, and he appreciated fully the importance, in every problem, of seeing clearly the exact bearing of the different principles of mechanics upon the subject, and of making use of such as lead to the simplest and most reliable conclusions.

I am accustomed to use the following illustration of the independence of internal and external motions with my class in mechanics: Suppose a car (Fig. 2) to have mounted upon it a flywheel, on the shaft of which

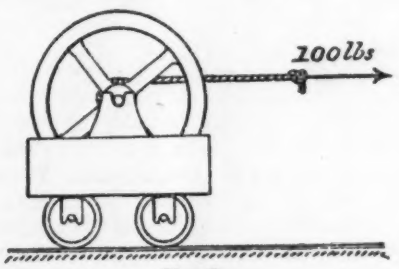


Fig. 2.

a rope is coiled. The rope is pulled in a direction parallel to the truck with a constant force of 100 pounds. What difference will it make in the motion along the track whether the flywheel is free to turn or whether it is blocked so that it cannot turn?

The principle of momentum solves the problem at once, for we have only to consider that the car and flywheel together constitute a body free to move horizontally, and that, so far as motion along the track is concerned, it is a matter of indifference whether there are also internal motions or not. The 100 pounds will produce a linear momentum of

* $h = \frac{u^2}{2g}\left(1 + G + \frac{fl}{m}\right)$

Note.—A review of the Hudelo-Peclet treatment may be expected at the next meeting of the American Society of Mechanical Engineers.

100 each second (neglecting friction), whether the flywheel is free to turn or not; so that the motion of the car will be the same as though the rope were fast to the car itself.

If, on the other hand, the problem be to find out how much work the force does in each case, account must be taken of the fact that when the flywheel is blocked the 100 pounds moves over the same space as the car, while with the flywheel free it will move over an additional space, due to the rope unwinding from the axle. The simple principle of momentum used above is now no longer sufficient, and the angular momentum of the flywheel must be found, and the work done in rotating the wheel added to that done in moving the car and wheel along the track.

Lighting Cars.

The *Railroad Journal* says that the horrible accident which occurred on the Cincinnati, Hamilton & Dayton Railroad on January 17, reiterates with terrible emphasis the necessity for taking every precaution to prevent the repetition of such calamities. In this case, as in other instances of a similar kind, passengers were fastened in the wreck and burned to death in the presence of the onlookers, who could give no aid, and were helpless to prevent the awful agony which was greater than that of a martyr burned at the stake.

Heating by steam is making progress, but not as rapidly as circumstances demand, as is shown by this and other accidents; but the influence of State legislation and the Railroad Commissioners is now exerted in favor of its general introduction; although it will probably require the sacrifice of more lives, the stimulus of public indignation, and the strong hand of the law to overcome the lethargy of railroad directors and managers.

The subject of lighting cars has received less attention than heating, because the danger is less apparent. That carrying several gallons of very combustible oil, which is distributed in a car where, in case of an accident, it will be most effectually scattered, is a source of great danger, is very obvious. Besides this, if cars are ineffectually lighted, it imposes upon passengers from three to six dismal hours in which reading is impossible, and they are driven to reflect on their misfortunes and shortcomings, which leads to a low state of dejection and melancholy.

Railroad companies have not the excuse any longer that there is no satisfactory system of lighting cars excepting oil lamps. It is not our purpose to sit in judgment on the relative merits of the various systems now in use; but it can be said confidently that if there is none better, the Pintsch system is giving satisfactory results. It has been mentioned in these pages before, that an unwillingness to profit by the experience of others appears to be a national defect in the American character. Precedents are, however, useful guides. In the matter under consideration we have the fact before us that the Pintsch system of lighting cars is used extensively in England, Germany, France, Holland, Italy, Austria, Russia, Sweden, Denmark, Switzerland, Egypt, Brazil, and also in this country, on nearly, or quite, 30,000 cars. The use is not recent either, but has extended over a sufficiently long period to fully test the efficiency of the system. The rate of increase also shows that its use has been sufficiently satisfactory to lead to a rapid extension, as from 1883 to 1886 about 23,000 cars were equipped with it. In this country it is used on the New York, Lake Erie & Western Railroad and ferry boats; the West Shore Road and boats; New York, Providence & Boston; Chicago & Atlantic; New York Central & Hudson River; Boston & Albany; Old Colony; New York & New England; Louisville, New Albany & Chicago; Cincinnati, Hamilton & Dayton roads; Pullman's Palace Car Company; Wagner Palace Car Company; Providence & Stonington Steamship Company's boats; Hoboken Land & Improvement Company's boats; and the New Jersey Central and the Cleveland, Cincinnati, Chicago & St. Louis Railroads are erecting works for future use. In all over 1,000 cars in this country are lighted by this system.

The following description will give a general idea of its essential features:

Process of Manufacture.—The material used for the manufacture of Pintsch gas is crude or refined petroleum, or the residual products of coal oil distillation. Crude petroleum is the cheapest material, and the one generally employed. The oil is passed through suitably arranged iron retorts kept at a high temperature by a coal fire below them. The furnace is of such design that the retorts are evenly heated from end to end, and are kept at such a temperature as to thoroughly convert into gas the oil, which is fed into them through specially arranged pipes and graduating cocks. The product is a rich and permanent gas, and of the highest illuminating power known in the art. From the retorts it passes through water seals, and is led by a pipe to the condenser, where it is cooled. In this it deposits the vapor of water, tar, etc., mechanically carried over with the gas. From the condenser it passes through a washer, which further purifies it, and then through lime purifiers, which effect the removal of all traces of impurities which may still remain. It is then measured and passes to the gasholders, from which it is drawn by the compressor and stored under any desired degree of compression in the tanks, from which pipes lead wherever it is convenient to convey it for use. The process is a simple one, very direct and economical. A plant capable of making all the gas required for 500 cars is contained in a building 26 ft. 4 in. by 38 ft. 6 in., one story in height. The storage tanks may be placed where it is most convenient, and are larger or smaller in proportion to the requirements of the service.

Distribution to Cars.—From the storage tanks pipes are laid to such points in the yards as are most convenient for charging the reservoirs of the cars. These pipes are provided with suitable valves, and by means of special hose, with quick-acting couplings, the gas is transferred to the tanks under the cars. These tanks are filled to a pressure of 150 pounds. A very much higher compression can be obtained if desired, but experience has shown that it is not good practice to compress the gas more than is needed. The tanks are filled very quickly, and no time is lost on this account, even when the filling is done at an intermediate stations. A stop long enough to supply the engine with water or coal, or to change locomotives, is sufficient for filling the tanks.

Pressure Regulation.—At the pressures at which the gas is charged into the tanks, its combustion in lamps is impossible without perfect regulation. This pressure, it should be remembered, constantly though very slowly diminishes as the gas is burned, and the conditions of satisfactory lighting demand that while any gas remains in the tank in excess of atmospheric pressure it shall give as good a light as when the tank is charged to its full capacity. The regulator is placed under the car, and without attention and under all conditions of service maintains a constant pressure of gas on the pipes leading to the lamps, whether one or all are burning, or none are in use. It is entirely automatic, and when adjusted and put in position needs no further attention, and the cover of the iron box containing it need never be removed.

The Lamps.—The lamps manufactured for railroad service are of great variety, and are adapted to every kind of coach. Those for passenger cars are all made upon one principle. They are suspended from the ceiling, and one of the suspending arms furnishes the gas-way. Two or four burners are used, as desired. These are inclosed in glass globes, which perfectly shield them from disturbing air currents, and place them wholly beyond curious or malicious interference. Above the flames is a white porcelain reflector, which greatly aids in the distribution of the light rays, and very much increases the brilliancy of the illumination. These lamps are shadowless, and, as travelers by the lines on which they are employed have observed, four lamps in a passenger coach of full size, give an illumination which permits the passenger to read easily and comfortably.

After the works and the machinery are erected it is said that this system is cheaper than lighting by oil; it is certainly much cleaner and safer, and, as remarked in the early part of this article, we are not prepared to sit in judgment on all the methods of lighting now before the public, but it may be said confidently that if no better system can be found than the Pintsch, railroad companies should adopt it in preference to oil, if for no other reason, to prevent such dreadful accidents as the one already referred to and others equally horrible.

Mr. Jno. West on Gas and Electricity.

At the annual meeting of the Manchester Association of Engineers, the President (Mr. Jno. West, M. I. C. E.) delivered a very comprehensive address, a large portion of which dealt with the subject of gas and electricity. An abstract of his remarks in this respect is appended:

Having referred to the gradual advance made in electric lighting from the time of the display at the Paris Exhibition of 1878, and subsequently in conjunction with gas, at the Crystal Palace, in 1882-3, the President noticed the first legislation in regard to the new system of illumination—the passing of the Electric Lighting Act of 1882—and the important amendment lately made therein by the extension of the time which must elapse before undertakings can be acquired by local authorities, and the modification of the terms under which the transfer is to be made. These alterations, he pointed out, had encouraged electric lighting, and companies had sprung up in London and the provinces to lay down plant for supplying the light. In some cases, where the gas works belong to the municipalities, they themselves had obtained powers

to supply the electric light as well as gas. Ten companies had been formed for lighting London, with a united capital of more than £3,000,000 sterling. The systems under which electricity is supplied by these companies—viz., the direct continuous current and storage, and the alternating transformer systems—were next described; and credit was given to electrical and mechanical engineers for having produced some very superior steam and gas engines and dynamos, and generally improving the plant, so as to ensure steadiness of light. The charges, Mr. West stated, were 7d. to 8d. per Board of Trade unit of 1,000 watts; and he added that some companies would not furnish a supply to a consumer under a minimum charge of £14 per annum.

While admitting that electricians had made some progress in perfecting machinery for securing a better and more regular supply of electricity, the President said it must not be forgotten that improved lighting by gas had also made very rapid strides. He mentioned that 13 years previously he read a paper before a Philosophical Society upon the "Economic Consumption of Gas;" and another during the year 1882, at the Smoke Abatement Exhibition in Manchester, where he displayed a number of defective burners that had been used by the consumers, and compared them with the more recent and improved burners then obtainable, when it was found that a great many consumers were not getting out of the gas anything like the illumination it would afford even with a good ordinary burner. Since that period, two new systems of burners had been perfected—those of the regenerative type, with which were associated the names of Siemens, Sugg, Wenham, Fourness, and others, and the incandescent burners of Welsbach, Clamond, and others. The burners, particularly those of the regenerative kind, had come into general use, and from them a better light could be obtained with from one-half to one-third the quantity of gas. In support of this statement, the results of tests of the various kinds of burners referred to—made by Mr. A. Smith, of Aberdeen, and Messrs. W. Foster and C. J. Lambert—were given.

The President next proceeded to compare the relative cost of gas and electricity, with equal light from each. He pointed out that eminent electricians state that a 16-candle power incandescent lamp is calculated to last about 1,000 hours, during which time it would absorb 60 Board of Trade units of electricity. The cost of this at 8d. per unit, would be 40s., to which must be added 3s. 9d., the cost of the lamp—making a total of 43s. 9d. per 60 units, or 16,000 candles. To make the comparison clear, he gave the cost of gas in London, Manchester and Aberdeen to produce the same amount of light, both with ordinary and regenerator burners. The results are shown in the following table:

	Quality of Gas.	Consumption to Produce 16-Candle Power per Hour.	Consumption Required for 1,000 Hours.	Price per 1,000 Cubic Feet.	Cost per 1,000 Hours.	No. of Times Gas is Cheaper than Elect'y.
Ordinary Burners.	Cand.	Cub. Ft.	Cub. Ft.	s. d.	s. d.	
London	16	5.00	5,000	2 6	12 6	3.5
Manchester	20	4.00	4,000	2 6	10 0	4.4
Aberdeen	28	2.88	2,880	3 6	10 1	4.3
Regenerative Burners.						
London	16	2.50	2,500	2 6	6 3	7.0
Manchester	20	2.00	2,000	2 6	5 0	8.7
Aberdeen	28	1.44	1,440	3 6	5 0½	8.7

In reference to the preceding table, the President remarked that possibly he might be charged with having compared the electric light with both the best ordinary and regenerator burners. To this he could only reply that these burners were within the reach of all consumers, and that it would be to their great advantage to adopt them. He pointed out that he had compared the gas with an electric lamp assumed to give the same light throughout the 1,000 hours; but this was not the case, as it was found that after they had been used for a time the carbon filament became volatilized and deposited on the glass, consequently the size of the filaments was diminished and the surface of illumination reduced—the carbon on the glass further reducing the light. These facts had been confirmed by the experiments of Mr. Preece, Chief Electrician to the Post Office, who stated that ordinary commercial lamps consuming 3.54 watts per candle power when new, required 6.1 watts per candle power after burning 900 hours—the mean absorption being 5.25 watts per lamp. Stated the other way, it appeared that the candle power of the lamps after burning 900 hours was only 58.5 per cent. of the initial duty; and the mean value of a lamp during its life was only 67 per cent. of that which it possessed when new. Assuming an average use of four hours per day for a lamp, this meant not only that all incandescent lamps must be renewed before 225 days (when their luminosity was little more than half what it was when new), but, taking all the lamps in an establishment together, three should be provided to do the work of two if the intended average lighting effect was to be maintained. The President said he was prepared to admit that the introduction of the electric light would be advantageous compared with gas consumed in ordinary burners, when a room was low-pitched, without any means of ventilation, and where a number of people were assembled assisting in the vitiation of the air. At the same time he was bound to say that by the adoption of regenerative gas burners not only would the maximum illuminating power per cubic foot of gas be obtained, but the products of combustion would be carried away without being permitted to enter the room, and the warm vitiated air would be removed as it rose to the ceiling. It appeared to him that some people preferred the electric light for reasons outside its advantages as a lighting agent—one because of its value as an advertisement, another because it was fashionable, and so on. But let the cause be what it might, he saw no reason why they should not have the electric light if they had a fancy for it, and were willing to bear the additional expense attending its adoption.

Mr. West then proceeded to give his views as to the cheapest and best way of producing and delivering electricity to the consumer under varying circumstances. He said he had been informed that in one town a complete electric lighting plant, driven by steam power, for the supply from a central station of 3,000 incandescent lamps of 16-candle power, with cables laid along the streets, would cost about £20,000. Mr. J. Ferguson Bell, of Stafford, had stated that in his town it would cost £14,500 for a like installation without reckoning the cost of land. Then there was the plan of supplying oneself (provided the number of lights was sufficiently larger) by means of a complete plant, driven by a gas or a steam engine, on the consumer's own premises. He had been supplied with the cost of a complete electric installation, including fittings for 320 incandescent lamps of 16-candle power each, which had been working for about two years at one of the banks in London. The plant was driven by gas engines, and the building being very dark, the lamps had to work for about 1,800 hours per annum. The following were the figures supplied to him:

Outlay on Plant.

Two 9-horse power "Otto" gas engines and fixing	£650 0 0
Two dynamos	300 0 0
Two sets of accumulators	1,250 0 0
Fitting up the bank throughout with wire, lamps and all accessories, including architect's charges	800 0 0
	£3,000 0 0

Working Expenses.

Gas used, 2,000,000 cubic feet, at 2s. 6d. per 1,000 ft.	£222 0 0
Proportion of wages of attendant who does other work	75 0 0
Oil, waste and water	25 0 0
Repairs to engines and dynamos, and depreciation at 10 per cent	95 0 0
Repairs to accumulators, and depreciation at 15 per cent	187 10 0
Cost of renewals of incandescent lamps (each burning 1,000 hours, at 3s. 9d. each)	108 0 0
	£712 10 0
Interest on capital, at 10 per cent	300 0 0
	£1,012 10 0

Current of electricity supplied, about 35,500 Board of Trade units.

Analyzing the foregoing figures, the President pointed out that the cost per Board of Trade unit for generating electricity, including wear and tear and interest on capital, was 5.58d.; interest on fittings, 0.56d.; renewal of lamps, 0.7d.—total, 6.84d. If the bank had obtained electricity from a company supplying from a central station at 8d. per unit, the total cost to them would have been as follows: Electricity, 8d.; interest on fittings, 0.56d.; renewal of lamps, 0.7d.—total, 9.26d. So that by generating electricity on their own premises they saved 2.42d per unit, or £357 19s. 2d. per annum. In this case, as shown by the accounts, accumulators were employed, so that the electricity could be generated during the daytime with smaller gas engines than would otherwise be required; but the loss of efficiency by the use of accumulators was about 20 per cent., and was a great drawback. He thought it would be found in practice that the most economical and satisfactory way of producing and supplying electricity to the consumers would be by gas engines on their own premises, or by a system of very small central stations, where a few houses or shops in close proximity could be worked by the direct system of distribution. By this plan it would be

possible to avoid expensive outlay on buildings, and at the same time to advantageously use the existing gas mains, as well as dispense with the cost and maintenance of an electric meter on the premises. The cost of generating plant for 400 16-candle power incandescent lamps, burning 1,800 hours per annum, on this plan of electric lighting by the use of gas engines and dynamos on the consumers' premises (already fitted up with wires and lamps) would be as follows:

Outlay on Plant.

One 20-horse power gas engine, fixed complete.....	£500	0	0
Dynamo.....	260	0	0
Slides, disc-wheel bearing and fixing, switches and cables in house.....	140	0	0
Total.....	£900	0	0

Working Expenses.

Gas used, 2,160,000 cu. ft., at 2s. 6d. per 1,000 ft....	£270	0	0
Proportion of wages of attendant.....	75	0	0
Oil, waste, and water.....	35	0	0
Repairs to engine and dynamos, with depreciation at 10 per cent.....	90	0	0
Proportion of rent, etc.....	100	0	0
	£570	0	0
Interest on capital, at 10 per cent.....	90	0	0
	£660	0	0

Current of electricity supplied, about 43,200 Board of Trade units.
Cost per unit of electricity, 3.66d.

In the case of an installation of direct generating plant for electric lighting by the use of gas engines and dynamos on the consumer's premises (already fitted up with wires and lamps), to supply fifty 16-candle power incandescent lamps, burning for 1,800 hours per annum, the cost would be as follows:

Outlay on Plant.

One 4-horse power gas engine, with dynamo, etc...	£275	0	0

Working Expenses.

Gas used, 270,000 cu. ft., at 2s. 6d. per 1,000 ft.....	£33	15	0
Proportion of wages of attendant.....	18	4	0
Oil, waste, and water.....	8	0	0
Repairs.....	6	0	0
Depreciation.....	13	10	0
Rent.....	4	0	0
	£83	9	0
Interest on capital, at 10 per cent.....	27	10	0
	£110	19	0

Current of electricity supplied, about 5,400 Board of Trade units.
Cost per unit of electricity, 4.93d.

By this plan electricity could be supplied, as shown by these examples, at prices varying from 3.66d. to 4.92d. per Board of Trade unit, according to the size of the installation, inclusive of working expenses, repairs, depreciation, and interest on capital. The usual charge by the London electrical companies, whose supply is generated for extensive districts in large stations driven by steam power, is 8d. per unit; showing a saving of 4.34d. and 3.07d. per unit respectively in favor of the gas engine scheme. To explain how the charge for working by gas was obtained, the President stated that he first took the quantity of gas required per indicated horse power per hour at 20 cubic feet. With this quantity of gas a maximum of eight lamps of 16-candle power each could be maintained per hour; and by allowing a little extra for irregularities, and taking 50 cubic feet of gas to produce one Board of Trade unit, the gas would cost 1½d., to which must be added the other figures in the table of working expenses.

Mr. West explained that the reason electricity could be distributed to consumers by gas engines cheaper than from a large central station was because the very expensive cables for distributing the electricity (which in most cases take one-third of the capital employed) could be dispensed with, as also the further expenses for renewal after the cables had been in use for a time. It was stated that Mr. Edison's cables in Berlin only last three years. These cables cost £90,000 for 36,000 lamps of 16-candle power and 144 arc lamps. From these facts it was quite clear that the interest on the first cost and maintenance and renewal of distributing plant alone would be more than the cost of gas delivered on the consumer's premises from the existing mains. He expressed the opinion that the Corporation of Manchester were quite right in taking steps to obtain a Provisional order from the Board of Trade for supplying the electric light, for which they could put up plant themselves, or employ other parties to supply them. They had excellent distributing plant for the purpose in the existing gas mains, which, by the aid of gas engines, would supply a power available at any time, requiring no constant attention, and causing no nuisance from smoke. These engines were already extensively used; Messrs. Crossley Bros. having sold 550 for the purpose. Where the outlay on plant was an impediment, he advised corporations and gas companies to throw more enterprise into their undertakings, and provide and let out on hire gas engines and dynamos in the same manner as they now let out cookers and gas stoves. In some cases it might even be advisable to sell the gas at a cheaper rate for electric lighting and heating purposes.

The President said he had not referred much to the use of arc or incandescent electric lamps for public lighting, because it had been proved over and over again that these lights could not possibly compare with improved gas burners and lanterns, either for cost or efficiency in lighting power. In many cases where arc lights of high power were employed on outdoor work they had been superseded by the Lucigen and Wells portable lights. Before leaving this subject, he said it must not be forgotten that in nearly all cases both gas and electric light are obtained from the energy contained in coal, and that gas companies and corporations who own gas works could produce as much light direct from the gas made from a ton of coal (if properly applied) as could be derived from a ton of coal by any other means, besides having the resulting coke, tar, and ammoniacal liquor to dispose of. Therefore, as far as he could judge, gas must remain by far the more economical of the two methods of lighting.

Mr. West concluded his address with an appropriate reference to water gas. He remarked that the subject of water gas had been brought very prominently before the public during the last year or two, more perhaps for the purpose of floating speculative companies than because of any real novelty in it; for at least 30 years had elapsed since it was new to English gas engineers. Many had been the trials of variations of the same principle, owing to the extreme simplicity of the apparatus and the large amount of work that could be done on a small area; but the question of ultimate economy had often prevented the success of schemes which were otherwise satisfactory. He explained that he was referring more particularly to the use of water gas for general lighting purposes, as there were many examples in England of its admirable qualities as a heating agent. Having described the method of generating the gas, he pointed out that there is a great difference between the circumstances of the production of water gas as a lighting agent in America and England, inasmuch as in America the petroleum oil used to invest the gas with lighting properties is easily obtained at a very low price, and the price of coal gas is much higher than it is in this country. A greater margin thus exists between the two kinds of gas. As a heating agent water gas was, he said, very valuable where a high flame temperature was desirable; as the theoretical temperature was about 5,000° F., while that of coal gas was about 2,500° F. He went on to show that mistaken notions are frequently held by persons not specially interested in the question, though of thoroughly scientific education, as regards the heating value of ordinary coal gas compared with the so-called "heating gas." He said the fact was that, roughly speaking, the better the lighting qualities of a gas the greater its heating value; and a far larger number of heat units were contained in a pound of ordinary coal gas than in the same weight of the best "heating gas" (taking the term "heating gas" to be simply a name to distinguish it from a gas which had not only greater heating value but lighting value as well) yet produced. As a lighting agent water gas had to be carbureted, or employed with some material capable of being raised to incandescence, such as magnesia, in the form of a comb, which, however, required a frequent renewal. English engineers who had visited America to inspect the water gas processes in use were of opinion that it might be an advantage to adopt the same system to a certain extent in England if petroleum could be bought at a sufficiently low price to make the gas a commercial success: but he thought this was very questionable.

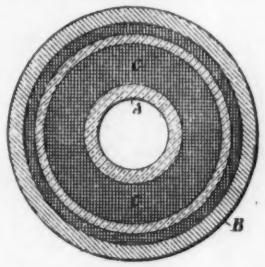
ACCORDING to the annual report of the Manufacturers Natural Gas Company, of Pittsburgh, the gross receipts for the year are returned at $235,149.38, and the expenses for same period were $151,839.97. The net receipts were $83,309.41. During the year the Company claims to have expended $58,128.27 in "permanent improvements," a portion of which was devoted to the burying of 36 miles of 12-inch pipe. The main mileage of the Company is returned at 136.

[Concluded from page 139.]

The Dangers of Electric Lighting.

By S. Z. de Ferranti and Francis Ince.

In order to use the electrical current two mains or conductors are required, an out main from the central station, and a home main (and one intermediate or third main is also required where the three-wire system is used), and each lamp that has to be lighted has one end of the filament joined to the one main (say, the out main), and the other end to the other main (say, the home main), the passage of the current from the one main to the other through the carbon filament causing the filament to incandesce and to give light. Now, if the mains from the central station are constructed with one tube of copper within another, and with insulation between, as shown in the figure, the central ring, marked *A*, being the out main, say, and the outer ring *B*, being the return or home main, the shaded part between the two being the insulation, the only leakage of current that can ever take place is, say, from *A* to *B*, if there is any defect in *C*, and the current returns to the station through the leak by *B*, without passing through a lamp or doing any work, and



if the leak is so serious between *A* and *B* that it causes a larger quantity to go back to the station than the bridge there will stand, the bridge melts before any damage is done to *A* or *B;* and if another main or wire actually comes in contact with *B* the current will not leave *B* and find the way back by the earth (as it would do if two separate out and home conductors were used), but it is controlled by *A*, and any leakages can only be to *A*. Hence, with a conductor constructed, as above shown, with a current passing through it of 10,000 volts, any one may hold *B* in their hands and they will receive no shock and no current will pass into them. This has been practically demonstrated by a test on the underground railway, where one of the writers held, as many others did, *B* in their hands, while a current of great pressure was passing through it, a pressure that would have meant instant death if it had been possible for the current to leak from *B* and pass through the body to earth. Thus we have the double safety, the bridge and nature of the conductor used, this safety being not only, as the reader will observe, a safety against fire, but it is an absolute safety to human life. And thus a man may work in close proximity to a conductor constructed as suggested, in fact, he may sit on it while he is working, and he will be out of all danger, and he is no longer, as Mr. Edison suggests, in fear of a "death-dealing current," for the current, whatever its pressure, whatever its quantity, is so controlled as to be absolutely harmless. Thus, to sum up the meaning of the above concentric mains, we may say that, whatever fault may occur, the whole effect is produced and contained in the main itself, and it is impossible that there can be, and there is in fact no danger and no damage done outside. We have thus a perfect protection for life and property from all forms of current.

Again, Mr. Edison says there is "no known insulation which will confine these high tension currents for more than a limited period;" and again he says, "the influence of the air or of gas or other agents renders it (the insulation) finally very susceptible of being pierced by a spark of static electricity." Mr. Edison would have been more accurate if he had said that there was no insulation known to him which would confine these high tension currents for more than a limited period; and, again, how can the air, gas or other agent get at the insulation if it be confined between two tubes in the way suggested and they are properly joined the one tube to the next? Again, if the mains be constructed according to the figure, and a spark of static electricity did pierce the insulation, what would be the effect? There would be no danger, no external damage; too great a quantity of current would flow over the bridge, and the bridge would give way, and, as before explained, no detrimental effects would be produced. But there is an insulating substance known which was manufactured before the commencement of the Christian era of which specimens that have been exposed to the air for centuries still exist in perfect preservation. How will such an insulator stand when hermetically sealed between two tubes? Then, again, Mr. Edison says, "the risk, too, is greatly increased by the fact that consumers who are supplied with current from a low tension system are accustomed to handle their electrical appliances freely, knowing them to be harmless; I say nothing of the injustice to vendors of harmless supplies of electricity." Here, again, Mr. Edison knows, and no one better, that even if the current is sent out from the central station at a tension of 10,000 volts, the tension is lowered at distributing stations by a suitable device, and that current the consumer has to handle is only at a pressure of 100 volts, and the pressure is so lowered and controlled that by no possibility whatever can the higher pressure get into any house. What, therefore, is the difference in the danger to the consumer whether the current has an initial pressure of 100 volts or 10,000?

Mr. Edison speaks of the alternating current as being more dangerous to life, and no doubt it is, if a high pressure were used in the customers' houses; the writers were, however, both present when Colonel Armstrong, as the representative of the Board of Trade, called upon them for the purpose of trying the effect of shocks from an alternating current at varying pressures, and in our presence he first of all took a shock from an alternating current machine at 50 volts; he then had the pressure increased to 100 volts, and then to 150 volts, and then to a pressure of 200 volts, at which pressure he said he was satisfied, and he could bear the 200-volt shock with perfect ease, being a pressure of twice that used in consumers' houses; in fact, in the Board-room of the London Electric Supply Corporation there are two openly exposed terminals, and the Directors constantly take hold of these, the effect of the 100-volt alternating shock being hardly perceptible, and being rather pleasant than otherwise. Further, we have had several accidents where men in the station have received a shock direct from the machine with a 2,400-volt alternating current, but not in one instance has death resulted. Mr. Edison speaks of the danger to life of alternating currents at low pressure, but it must be borne in mind that the specimens experimented on at Mr. Edison's laboratory were pickled and prepared so as to make the effects of the current as deadly as possible, and were therefore placed in an unnatural condition.

This article shows that the saving of copper in the mains or conductors is enormous as the tension increases, and what this means may be made more clearly apparent by a statement of the fact that if the pressure from the station was 100 volts only, the stations to light London could not be placed at a greater distance than a mile apart, each station lighting a half-mile radius, as otherwise the copper mains would have to be of such an enormous size to carry the quantity of current that would be required at this low pressure, that the cost of mains alone would render the price at which the current could be supplied so high as to make lighting by electricity impossible.

Again, it is much more costly to build a large number of small stations than one large station, and every small station requires its staff, its engine drivers, etc. In a large station one man can drive a 10,000-horse power engine which will light 200,000 10 candle power lights, whereas with small stations and small engines, say of 250-horse power each, which would light 5,000 10-candle power lamps, each engine must have its attendant; and the question is not, as Mr. Edison would suggest, a mere question as to saving a few pounds "in investment in real estate and copper;" it is a question of saving so much as to make the difference between success and failure, where it is necessary to compete with gas at a low price. But this is not all; in large cities it is impossible to buy land at every mile, and to put up a central station for the manufacture of electricity, for the station is a nuisance, and one is perpetually harrassed with litigation; application after application is made for injunctions; the taking of coal in the large quantities required is a nuisance; the smoke is a nuisance, and only high-priced steam coal can be used, and that, too, saddled with the heavy expense of cart carriage; the vibration and noise from the engines is a nuisance, and stations in the residential parts of any city will be stopped one after the other by injunction.

Again, at these small stations spread over a city, to get water is a difficulty, and in consequence power can only be obtained at a very high rate of coal consumption; whereas, with a suitable site at a distance, the quantity of coal used can be reduced enormously, making a saving which will alone go far towards a dividend on the capital expended.

These are all circumstances that require most serious consideration, and Mr. Edison's argument on these points is in fact a mere argument in favor of a monopoly for his low tension system, a system which can exist and be carried on profitably in America, where the price of gas is enormous; a system which would render electric lighting impossible in London with gas at 2s. 5d. per 1,000 cubic feet, and a system which makes the people of America pay a price for their lighting unnecessary to give a good return on capital invested on a better and a less costly system.

Mr. Edison points out that a larger number of fatal accidents have occurred through electricity in New York than in any other city in the world, and gives the reason that New York has a greater number of wires overhead than any other city in the world. No doubt this is the reason, coupled with the fact that probably in no other city in the world are the overhead wires arranged more negligently and with more disregard for the care of human life. There can be no doubt but that overhead wires, whatever the care may be that is taken with them, are, and always must be, a danger; but with conductors placed underground, and with due care, and properly constructed, there can be no danger whatever. Mr. Edison has pointed out that in this country the safety of the people is placed in the hands of the Board of Trade, a body we have found most obliging and most reasonable in their requirements, while insisting with the utmost severity that no system shall be adopted which does not give absolute safety to human life, and who, after seeing our work, have been perfectly satisfied to advise the government to pass our Act, which enables us to deal with a 10,000-volt current.

Mr. Edison does not deal with the transmission of power from those sources which nature gives us for nothing at certain centers; we refer to water power, and from which, by the aid of high pressure electricity, and high pressure electricity alone, can the force be transmitted to a distance and utilized for the purposes of man; according to Mr. Edison these forces are to run on unutilized forever as they have done for ages past. His argument that because a nitro glycerine factory is dangerous on the surface of the earth we should not think of putting it underground, is not applicable to the subject of electricity or to the putting of electric mains underground, though we cannot say that the idea of the nitro glycerine factory underground is so absurd as Mr. Edison appears to think; for it will be within the memory of many of our readers that about fifteen years ago a barge laden with gunpowder, on the Regent's Canal, exploded at the bottom of the Avenue road, where the canal is in a deep cutting, and the opinion of one of our great experts was that this fact saved London, serious as the damage was in the immediate neighborhood. It is clear beyond a doubt that if mains are properly placed underground there can be no danger, and no accident can take place.

We think we have said enough to show that the dangers of electric lighting are no more in the high tension system than the low, provided both systems are carried out with equal care and all proper safety devices are used in the one case and in the other; without these devices and without this care neither system is safe, and it is clear beyond a doubt that the low pressure system is not safe as at present carried out in New York, and it never will be until the State steps in and the use of electricity is regulated there by well-devised rules and under the supervision of competent officers; but Mr. Edison is as far behind the time when he suggests that no station shall send out a current at a pressure exceeding 100 volts as the alarmists were when railways were first introduced, and it was considered that no train could in safety ever run at a rate exceeding twenty miles an hour.

No doubt if a train ran at only ten miles an hour an accident would not have such serious results as with a train running at fifty miles, but is this an argument why trains should not run at fifty miles per hour? We have to consider the percentage of risk, and this we find has not been materially increased by the increase of speed. So it is with electric pressure. As the pressure increases, extra precautions have to be taken with regard to safety, and we believe with Sir William Thomson, who stands as an authority in the world of science as high as Mr. Edison, that it is not a question whether a pressure of 10,000 volts (the highest pressure yet utilized) is to be used or not. The pressure may be anything so long as proportionate precautions are used, and we think it may be that in a few years' time people will think as little of 10,000 volts as we do now of 1,000, and will laugh at the present alarmist idea that in a pressure of 100 volts the limit of safety has been reached.

Mr. Edison says in his article: "The public would scarcely be interested in the details leading up to the conclusions to which I have come, for the reason that it would involve a mass of matter such as they have been attempting to digest during several months past." We have not adopted Mr. Edison's dogmatic method of dealing with the subject, and do not know to what mass of matter he refers. We have avoided attempts to give results the weight of our opinions without giving reasons; we have explained as clearly as we are able our views, giving such reasons as would enable the general public to follow our arguments without, we hope, too much trenching on the land of technical science, and we trust our readers will see that there are other arguments besides those of Mr. Edison, and that there are reasons why the dangers of electric lighting under a high pressure system are no greater, if they are so great, as those of a low pressure system, for which Mr. Edison clearly claims (while he disclaims) a monopoly.

Mr. Edison very properly gives great weight to facts. Let him then consider that in New York the deaths through electric shocks have been very frequent, with a tension, we believe, never exceeding 2,000 volts, and rarely exceeding 1,000; while in London, where for years we have been using a tension of 2,400 volts, with miles of both overhead and underground conductors, we have never had a single accident with our mains or a single death. Why this difference between London and New York? The reply is, that here our work is done properly, there it is not. Our work is put up to last, theirs in New York to serve the purpose of the moment.

If the reader has followed us so far and will allow us in closing this article to be prophetic, we will say that in the future our railways will be worked, our lighting will be done, our power will be transmitted to a great distance; all this will be done entirely by the aid of high pressure electricity; it is high pressure in electricity like high pressure in steam, which is going to carry—which is carrying—everything before it, and this high pressure will be used, and will be doing the work of the world, when the low pressure system Mr. Edison now so strongly advocates has passed away and been forgotten.

Three Types of Electric Meters.

La Nature recently published an article descriptive of three types of electric meters that were first publicly displayed at the Paris Exhibition. In the illustrations Fig. 1 stands for a general design of Blondlot's watt-hour instrument. M. Clerc's watt-hour device is outlined in Fig. 2, while the meter of MM. Paccaud-Borel is pictured in Fig. 3. The watt-hour devices are for continuous service current, while the last-named apparatus is for alternating work. Blondlot's meter is constructed with two essentially distinct parts—the measuring apparatus and the integrating apparatus. The former of these is an electro-dynamometer whose fixed bobbin with vertical axis is wound with coarse wire and is traversed by the total current furnished to the consumer. The fine wire bobbin placed within the coarse wire one is mounted in derivation between the distribution terminals of each subscriber. The couple exerted upon the movable bobbin by the fixed one is thus proportional to the product, e I, of the intensity, I, of the principal current by the difference of potential, e, at the terminals of distribution. A counterpoise arranged upon an arm mounted upon the axis of the movable bobbin balances the electro-dynamic couple and causes a deflection of this bob-

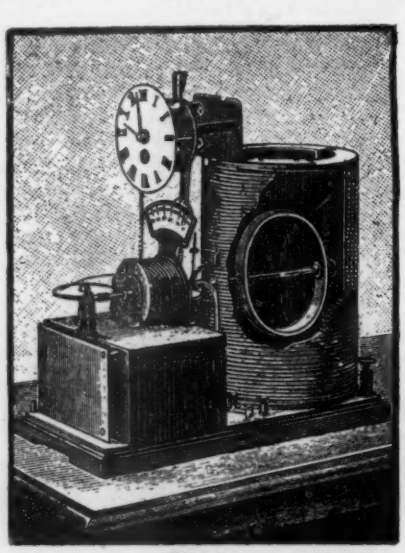


Fig. 1.

bin by an angle proportional to the product, e I. The clockwork movement, an ordinary timepiece, periodically closes (once every 5 minutes in the case considered) the circuit of a special derivation constituted by two solenoids. The effect of the first of these solenoids is to bring back the fine wire bobbin to zero, and that of the second, which is arranged horizontally, is to render momentarily interdependent the axis of an evolution counter which, in every operation, revolves by an angler equal to that made by the movable bobbin before being brought back to zero. The rotations thus given periodically to the revolution counter are totalized, and may be read upon a horizontal dial actuated by an endless screw mounted upon the first axis of the revolution counter.

The movable bobbin, in passing over a vertical dial placed beneath the clock, makes known the power furnished every instant by the apparatus controlled by the counter. The intervals of time that separate two

different gatherings may be read upon the dial of the clock, and the integrations made by the apparatus may be known from the horizontal dial, so that the consumer has under his eyes at every instant all the elements of verification that are necessary to him.

Clerc's meter, shown in Fig. 2, is in principle analogous to Blondlot's, but differs from it in the mode of periodical integration. The clock is kept in motion by a derivation from the line. It carries along, at a uniform angular speed, a crank fixed upon the principal axis. When the power expended is nil, the needle fixed upon the axis of the movable bobbin is in the position represented in the cut.

If a current passes into the two bobbins, the needle is deflected toward the right by an angle that counterpoises, properly arranged upon the

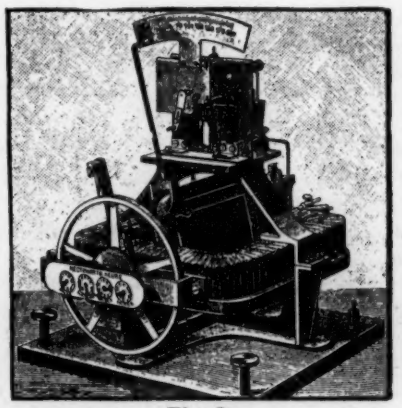


Fig. 2.

axis, permit of rendering sensibly proportional to the product $e\,I$. The crank carries the needle back to zero once per revolution.

These rotations are transmitted to the revolution counter, and totalized by means of a mechanical arrangement that may be seen in front in the figure. This arrangement consists essentially of a small finger suspended from a lever fixed to the axis of the movable bobbin. When the lever moves from right to left, it carries along the large wheel mounted upon the axis of the totalizer. In moving from left to right, the finger slides over the felly of the wheel, and the rotation effected in the preceding movement continues as in the Blondlot apparatus. The needle indicates the power in watts, and the counter the total of the watt hours furnished to the consumer.

The Paccaud-Borel meter is designed for the measurement of alternating currents. It belongs to the class of motor counters, and is based upon the special properties of the magnetic field produced by alternating currents of great frequency. Suppose there are two bobbins whose axes

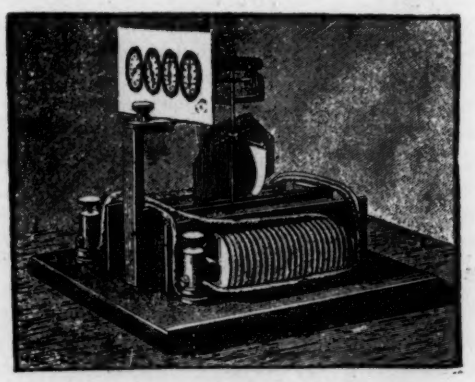


Fig. 3.

are arranged rectilinearly, having an unequal number of spirals, and mounted in derivation, one with respect to the other, so that the total current traverses them at the same time and divides itself unequally at every instant in each of them in consequence of irregularity of the coefficients of self-induction. Each of these bobbins will tend to produce a magnetic field whose intensity will depend at every instant upon the intensity of the current traversing it. The resulting field will be rotary in a direction determined by the attachment of the terminals between themselves. A thin iron disc placed in the rotary field will tend to turn in the direction of rotation of the field, and so much the more quickly in proportion as the field or the current producing it is more intense. Upon arranging vanes, forming a regulator upon the same axis with the disc, and upon properly proportioning the different parts of the apparatus, it is possible, as may be seen, to form a sort of electric motor, which, between certain limits, will revolve with an angular speed sensibly proportional to the efficacious intensity of the total current.

It is with a view to obtaining such necessary proportions as perfectly as possible that the practical apparatus does not entirely resemble the theoretical one that we have just described.

In the model represented in Fig. 3 one of the magnetic fields is produced by an electro-magnet; on the other hand, the vanes of the brake are movable, and they rise in order to preserve the proportionality at great distances in reducing the value of the resistant couple due to the air. The number of revolutions registered upon a counter is proportional to the quantity of efficient electricity furnished to the circuit.

The Financial Aspect of Natural Gas.

By Charles Harrison.

Although the natural gas industry is in its infancy, being but seven years of age in Pittsburgh, the pioneer city, it has had an important effect on commercial enterprise and economic conditions. Throughout the whole area of natural gas production, from Western Pennsylvania to the fields of Indiana, manufacturing has been stimulated, and the production of manufactured commodities and the consumption of raw materials, vastly increased, the effect of which is not limited to the gas producing territory, but is diffused throughout America. The commercial phases of the industry, the advantages arising from the use of such fuel to manufacturers, the comfort and convenience added to the homes of the people, the advancement in material wealth, additional employment to labor, and various other attributes of a substantial nature, have been widely discussed and generally understood. But the purely financial considerations attending this new industry and enterprise have as yet taken form so little removed from the speculative and experimental as to make definite conclusions nearly impossible. Financiers have nevertheless had considerable experience with the stocks of corporations engaged in the industry. Bonds issued in furtherance of such enterprises are occasionally offered, and order is so gradually emerging from chaos that indications of permanent truth and reliable principles are making their appearance.

The first feature presenting itself to financial consideration is that the industry has from its inception been in the hands of companies or incorporations. Individuals have leased territory and produced gas, and they will probably continue to do so; but in all States wherein natural gas has been utilized as fuel, the distribution has been made to consumers by incorporations. One leading reason why this must continue to be the case is that the places of production are at considerable distance from the places of consumption, the intervening territory being occupied and owned by many persons. In order to obtain rights of way for the pipes through which gas can be conveyed, the power of eminent domain is frequently essential, and this is conferred on corporations exclusively. There is no probability that natural gas can ever be successfully handled by private individuals. A large number of corporations have accordingly been organized to conduct the business. Their stocks have been on the public markets, and their values have become, to some extent, known through the quotations obtained from trading in them. The market has varied widely, the same stocks fluctuating between 135 per cent. of their par value and 32 per cent., often without material difference in their dividend earning capacity, the regularity of dividend payment, or any other known reason than speculative causes. At present, to find a natural gas stock on the market worth par is a decided exception, notwithstanding the fact that several have been paying dividends of from 9 to 12 per cent. per annum regularly for a term of years, and are still in a position to continue them.

All natural gas stocks are speculative and subjected to so many influences against which no human foresight can afford protection, that however valuable they may be as immediate profit payers, they have never risen to the dignity of legitimate investments, and there is no prospect that they ever will. They cannot, for many years at least, from the fact that the sources of supply are beneath the earth, where the human eye can never penetrate, and, unlike many other mining operations, the extent of the "vein" or "lode" cannot be even surmised, much less surveyed. That the wells from which the supply is obtained are really exhaustible, howsoever great may have been their output or uniform their pressure for years, has become a demonstrated fact. No inexhaustible natural gas well has yet been discovered, or one which has not suffered a diminution of pressure, though this fact was denied only a few months ago. Increasing demand upon productiveness has led to more rapid exhaustion, and the rate at which companies have been compelled to seek new territory has been accelerated.

All the great companies, a few years ago, were supposed to be in

possession of territory practically inexhaustible, but there is scarcely a great company in existence, after five years of experience, that is not seeking new territory on account of diminishing supply from those fields which promised to be permanent. That several of the companies have been successful in finding new and prolific territory, is matter for congratulation to the stockholders; but such extensions involve expenditure not contemplated in the earlier days of the enterprise. It is evident that the wells cannot be brought to the pipe; the pipes must therefore be extended to the wells. Every new well drilled, and every foot of pipe laid to make its production available (if, indeed, there be any production), causes an additional outlay of capital which would not have been the case had the wells been originally inexhaustible, as contended. New territory adds still more to the disbursements of the corporation, whether it be obtained in fee or on royalties; and the extension of the pipe system is generally much greater to new territory than from line to well in territory already in possession. It therefore becomes a matter of interest in some cases as to whether these extensions of the pipe lines of companies to new wells in the old or in new territory, and the new wells themselves, which have been found to be imperatively necessary to the successful operation of the plant, should be charged to the stock or the expenses account. It is in dispute and undecided; but in case of leased lines, it makes a vast difference where a division of profits is made the basis of rental. Natural gas may be inexhaustible in the aggregate; and the supply may be all that is claimed for it by the most sanguine of those engaged in the industry. But the extensions of lines and additional expense on account of the exhaustion of wells in all known fields, is a truth too well established to be successfully refuted. How far this may have to be continued, with what rapidity it may be required to supply the demand in the future, cannot be known. This very element of uncertainty will always keep the financial aspects of the industry purely speculative, and render it impossible to attain such a settled condition as to make a legitimate investment, or the stocks of the companies such securities as a court would order trust funds to be invested in, whatever present profits or prospective gains of particular companies may be.

From an economic point of view, it is evident that the cost of production of natural gas must increase as long as wells are exhaustible. Territory becomes scarcer and more uncertain, and the plant of companies larger and more expensive to maintain and operate. At the same time the price to the consumer cannot be arbitrarily advanced to meet this increased cost of production, because there has been no exhaustion of coal fields nor of means of transportation. As much solid fuel of all kinds is within as ready reach of consumers as was the case before natural gas was introduced as fuel; besides which new competitors have appeared in the market. The prolific oil fields of Ohio, particularly, have been ultilized for fuel purposes, since natural gas was introduced, and they make a highly successful competitor where conditions are favorable to its supply and gas has to be piped a long distance. Beside oil as fuel, manufactured fuel gases are being devised, and have already supplanted coal in some localities. They are claimed to present nearly as desirable economic features as natural gas itself. Competition must prevent any great advance in the price of natural gas. With constantly and inevitably increasing cost of production, and no opportunity for a corresponding cost to the consumer, what is to prevent ultimate bankruptcy of every natural gas company? Clearly, nothing but the economies rendered possible by experience in distribution, or increasing its effectiveness in use. By the knowledge which comes from experience alone can they be saved. The number of gas companies already rendered insolvent, sold out by the sheriff, or absorbed by other more prosperous companies, is a practical suggestion that it takes something more than gas producing territory, a pipe line, and customers to make a successful natural gas plant. Not a company went into operation without all these, but the number of financial wrecks is very large for the length of time the industry has been in progress, and the supposed profit there is in the business. The great problem is whether the advantages of skill and information derived from long experience in the production and distribution of natural gas will be able to keep pace with the continued cost of production. Whether it be possible or not, the conclusion is unavoidable, that the longer the natural gas industry is continued, the more hazardous it becomes for inexperienced persons to embark in it.

The petroleum industry was long recognized as being the most uncertain and speculative of mining operations; but natural gas is even more speculative than petroleum. All the uncertainty in the production of oil is present in the production of natural gas; but in oil the uncertainty ends. Petroleum has a market throughout the world. Gas has no market except at the end of the pipe. Petroleum having been procured, a variety of ways of transportation are possible. If in barrels it becomes too expensive, the tank car is available; if the tank car costs too much, the pipe line can be laid down; or the reverse order may be resorted to in extremity. But in handling natural gas but one means of transportation is possible. In natural gas the place of consumption is fixed. No further can it go to get a better price. It has all the disadvantages and uncertainties of oil; while in points of conveyance and market it has none of the advantages. In 30 years petroleum has never ceased to be a speculative commodity; the stocks of the companies engaged in the enterprise equally so. Natural gas companies must be even more of a speculative nature for a longer period, if they continue for that length of time.

Besides their stocks, the bonds of corporations engaged in the natural gas business have a degree of financial interest. The amounts thus far issued have been small, and all issues have been under such conditions as to present little from which satisfactory estimates can be formed of the value of such securities. So far as is known, there has been no uniformity in the issues of bonds by various corporations; and the conditions under which they have been made were so entirely dissimilar each to the other, that only general principles can be relied on in approximating the value of any particular class. The value of a bond depends principally, first, on its validity; secondly, on the credit of the corporation issuing it; thirdly, on the market value of the collateral security or tangible property pledged for its redemption; fourthly, on the rate of interest it bears, and the length of time it has to run. Natural gas companies organized and doing business in Western Pennsylvania have issued bonds, but they have been placed through private agencies on private terms, so that very little is publicly known of the value that has been placed upon them. It may be said, however, that the validity has never been questioned seriously; the companies issuing them having been regularly dividend paying institutions as a rule, and hence of good credit. Each company has mortgaged a plant costing far more than the face value of the bonds to secure the payment; and so long as there is a supply of gas, the collateral security is probably unquestionable. But from the exhaustibility of the wells from which the supplies are obtained, the comparative worthlessness of a pipe line having nothing to fill it with, and the constantly increasing expenditures of established companies more particularly pointed out above, the general rule, that the longer a bond has to run the more valuable it is, does not necessarily apply to natural gas securities. Besides these considerations, the risks of the business are so great, and its speculative character so pronounced, that a high rate of interest becomes essential to indemnify against the contingencies of the investment. The securities issued by a corporation partake, to some extent, at least of the speculative character of the business in which it is engaged. The business risks and expenses of a municipality are at least as great as those of a business corporation, and are liable to be much more so. Natural gas trustees are generally gentlemen of success in their vocation, but without practical knowledge of the details of production or distribution of natural gas. Practical affairs inevitably become more risky under inexperienced management than under the direction of experienced men. Bonds issued by a municipality under such management, and having nothing but public credit behind them, cannot be so desirable as those issued by business corporations, whose affairs are conducted by persons of experience in every department, and which give collateral security on their tangible plants as well as the security of experience and actually invested capital.

Improvements on Coze's System.

The London *Journal* points out that an improvement in inclined gas retorts, after the pattern with which his name is now identified, has been patented by M. Andre Coze, of Rheims. This patent covers the form of the retorts, the method of connecting them to the charging mouthpieces, and the construction of the charging truck or wagon. The retorts are for the whole of their working portion of the peculiarly flattened Ω-shape which M. Coze holds to be desirable for the proper distribution of the charge; but both ends where they pass through the brickwork of the setting are of contracted area. It is claimed that by this means the disengagement of the gases is greatly facilitated, while the coal is distributed in a regular manner throughout the retort, and choking of the upper end prevented. The charging mouthpieces are made with sockets to fit on the ends of the retorts; and the bends by which the inclined axis of the retort is changed into the vertical are made with duck-feet in order to take their weight off the retorts. The alteration of the charging truck consists in making it carry as many tilting hoppers, provided with automatic closing gates at their lower ends, as may be required for use at one time. Thus, supposing a setting of three retorts to be in use—or,

which amounts to the same thing, three retorts out of a large setting require to be charged at the same time—a truck would be made to take the three tipping shoots, and this would save time. The shoots are provided with means for checking the too rapid fall of coal, or of large lumps, which might otherwise choke the opening into the retort below. It is regarded as an essential feature of this combination that the retort, the charging mouthpiece and the tilting hopper should together at the time of charging constitute a continuous passage for the distribution of the coal in the retort.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

THE Asbury Park (N. J.) Gas and Electric Light Companies have an understanding whereunder each refuses to supply light to parties that are in arrears on the books of either Company. There is sound sense in a combination of that character.

AT a special town meeting (Wakefield, Mass.) it was voted not to grant the Citizens Gas Light Company the privilege of erecting poles and stringing wires over the streets for the purpose of furnishing electric currents for light and power.

THE Western Gas and Fuel Company has been incorporated at East St. Louis by Messrs. Henry O'Hara, Jos. W. Shepard and Henry D. Sexton. It is capitalized in $500,000, and its objects are the manufacture and sale of gas for illuminating and fuel purposes.

THE Peoples Gas and Electric Company, to operate in the villages of Palmyra and Riverton, N. J., has been incorporated by Messrs. Charles H. Edgerton, W. H. Miller and Israel Roberts. It is capitalized in $50,000. The Company will construct and operate a gas and electric light plant. These are adjoining villages in Cinnaminson township, Burlington county, N. J., and are about 8 miles northeast of Camden. The joint population must be close to 5,800 souls, and both places are growing rapidly. There can be little doubt that a venture of the sort proposed will insure a fair rate of profit from the start.

MR. JOHN LILLIE, President of the newly incorporated Port Townsend (Washington) Gas and Fuel Company, writes us that the projectors are preparing to build their works, and expect to have the same in operation on or before next October. Port Townsend is the capital of Jefferson County, is on Puget Sound near the Strait of San Juan de Fuca, at a point about 44 miles northwest of Seattle. It has an excellent harbor, and is being developed rapidly. To show how its natural facilities for commerce have attracted the attention of those constantly on the lookout for such situations, we may note that ten years ago its population was returned at 593, whereas to-day it shelters no less than 6,500. Further, Mr. Lillie estimates that by the close of the year it will give residence to 10,000 people.

AT the annual meeting of the Grand Rapids (Mich.) Gas Company the following Directors were elected: Messrs. Thomas D. Gilbert, Noyes L. Avery, H. D. Walbridge, Wm. D. Gilbert, Chas. F. Rood and Philo C. Fuller. The Directors made quite a radical change in the personnel of the officers of the Company. Hon. Thos. D. Gilbert has been Secretary and Managing Director of the Company for many years—from its organization almost. He has in that time made the Company one of the best in the country, and while it has been profitable to its owners, it has also been considerate to its patrons, who have had the benefit of good gas at extremely low rates. In consideration of his years of activity the Directors determined to put the clerical labor on someone else, as their choice of officers will show. In organizing they made the following appointments: President, Hon. Thos. D. Gilbert; Vice-President, Noyes L. Avery; Secretary and Treasurer, H. D. Walbridge. In their annual report the Directors say they are "gratified to be able to report a very satisfactory condition of the property of the Company, and nearly the usual annual increase in all departments of its business." Commenting on the use of electricity, the report says: "The increase in the output of gas has been somewhat affected by the experiments now being tried by several of our large customers in the use of electricity. We have no fears for the future in our competition with electricity, unless very great economies can be introduced in its generation and distribution. As an offset to any future developments in that direction we are constantly doing something in the way of improving methods and economies in management, while our residual products are constantly increasing in value. It is well known that the price at which gas can be sold at a profit depends largely on the quantity that can be disposed of after the means for its production are established. The people of Grand Rapids have always been liberal patrons of the Gas Company, and we have endeavored to meet them more than half way by always keeping our prices at the lowest point consistent with reasonable dividends on our investment. We can point with pride to the fact that while the average price at which gas is sold in the United States is about $1.85 per 1,000 feet, in this city it is $1.14, while some of our largest customers have it as low as 90 cents. The wisdom of our Common Council in never having given serious encouragement to an opposition gas company is clearly shown by the fact that among the 20 cities in the Union where opposition companies have been given franchises there is no competition, and in not one of them is gas sold as cheaply as in this city. The low price at which gas is sold here has encouraged its use for cooking and heating, and the sale of stoves is rapidly increasing. The Common Council has also come to the conclusion that gas is the best and most economical means of lighting the streets, and when they give us permission to light the lamps 'all dark hours,' instead of by moonlight schedule, every one will be satisfied."

WE congratulate the management of the Grand Rapids Company on the success that has attended their efforts, the greater part of which, however, we make bold to assert, is fairly chargeable to the unremitting attention and liberal policy that have always been marked features under the administration of President Gilbert.

MR. KEPLINGER has introduced into the Lower House of the Maryland Legislature a measure which affects the Baltimore Consolidated Gas Company. Briefly stated, the leading features of the Keplinger scheme are appended: Sec. I. declares that the price of gas in Baltimore shall not exceed the sum of $1.25 per 1,000 cubic feet. If at that price the clear yearly profit of the Consolidated Gas Company, and in this Act called "the Company," shall exceed 6 per cent. per annum on the capital stock, to be paid as a dividend to the holders of said stock, the excess beyond that sum to the extent of 1 per cent. per annum upon said capital stock shall from time to time be invested in dividend-paying securities, including the bonds of several companies, of which "the Company" is a consolidation, and the dividends and interest arising from such securities, in order that the same may accumulate at compound interest until the sum so accumulated shall equal in amount the bonded indebtedness of "the Company," when, or as soon thereafter as it shall become due, said bonded indebtedness shall be paid, and that all excess of clear yearly profits of "the Company," beyond a sum sufficient to pay a dividend of 6 per cent. per annum to the stockholders as aforesaid, and 1 per cent. per annum with which to pay the bonded indebtedness as aforesaid, shall become the property of the city of Baltimore, and to be paid into the treasury of the city. Section II. provides that the books of "the Company" shall be open to the Commissioners of Finance of Baltimore, who shall report to the Mayor of said city annually what amount of the clear yearly profits of "the Company" the said city shall be entitled to under the first section of the Act, and "the Company" and its officers shall offer all reasonable facilities for such inquiry, and refusing to do so shall forfeit its charter. Section III. provides, in consideration of the performance by "the Company," it shall have the exclusive right to make, distribute and sell illuminating and heating gas in Baltimore, for the period of 25 years from the passage of this Act. Section IV. provides that the ordinary remedies at law and equity shall apply to all questions arising under the Act. Section V. provides that the Act shall become effective on June 1st, 1890.

WE also understand that another measure will be introduced at this session of the Legislature, the gist of which is that the Consolidated Company shall pay to the city the sum of $10,000 per annum in return for an exclusive franchise to furnish gas at the rate of $1.25 per 1,000, for a period of 25 years.

MR. FRANK W. PENWELL, one of the purchasers of a recently-acquired controlling interest in the Danville (Ills.) Gas Company, also acts as President of the local Merchants Electric Light and Power Company.

ON January 28th Mr. E. C. Jones received his appointment as Assistant Engineer of the Boston Gas Light Company. This is in addition to the position as Superintendent of the North End Station. His office will be at the North End plant.

PETITIONS are being circulated in Massachusetts for signature, the intention of the movers therein being to ask the Legislature to pass a general law under which cities, towns and villages may operate lighting plants on municipal account.

JOHN H. ELLIOT has been elected President of the Keene (N. H.) Gas Light Company, Mr. Geo. M. Rossman continuing to act as Treasurer and Superintendent.

SOME time ago August Evering, of Vincennes, Ind., determined to satisfy an incredulous local public that coal existed in paying quantities underneath the soil of Vincennes. Undismayed by their adverse prophecies Evering's shaft eventually reached the coveted material, and the prophets changed their tune from ridicule to adulation. Having raised about 5,000 pounds of the coal to the surface, it was decided that the product should be sold publicly at auction on a given day; and when the hour was at hand almost all Vincennes was within sound of the auctioneer's voice. The first bid was $20, which was followed by many others, or until the sum of $100 was announced, at which figure the black diamonds were knocked down to Mr. George G. Ramsdell, who remarked that "although the material came high," he had "to have it."

TWO days afterward the successful bidder succumbed to the advances of *la grippe*, from which we hope he will speedily emancipate himself.

GOSSIP in Belleville, Ills., is to the effect that negotiations were on foot which had for their object the consolidation of the Belleville Gas Light Company with the Brosius Electric Light Comany, which now has the contract for the public lighting. Mr. Abend, who is largely interested in the Gas Company, was interviewed on the subject, and admitted the proposition had some advocates, but that he was opposed to it. He further said: "The Belleville Gas Company can furnish artificial lighting at a rate below that which could be made by any other company. I am in favor of reducing the rate for gas to $1.50 per 1,000 from the first of April, and if the Council will afford the opportunity, I am in favor of submitting an offer of $15 per post per annum for gas lighting, and to supply arc lamps west of Illinois street for $75 per annum each."

WE do not see how the Council can very well overlook Mr. Abend's proposition, since the city is now paying the Brosius Electric Light Company $120 per annum, each, for the arcs in service. The contract, however, under which this work is being performed—it is a three-year agreement—expires by limitation on April 30th. Perhaps it is from this circumstance that the Brosius Company's owners favor consolidation with the Gas Company; and likely it also is that Mr. Abend's opposition to the amalgamation is based on the fact that the Belleville Gas Company, having struggled with the competition of the past three years, ought not now to be used as an instrument for propping the waning fortunes of the local electricians.

THE plant of the Chillicothe (Mo.) Gas, Electric Light and Water Company has been sold by Receiver W. E. Gunby, for $50,000, to Mr. Alexander G. Black, of New York. The latter will, in conjunction with his associates, make many improvements on the property.

THE proprietors of the Talledega (Fla.) Gas and Water Company have voted to bond the plant, the proceeds to be applied to extensions and betterments.

MR. HENRY W. BOND, attorney for the Laclede Gas Light Company, has requested Mayor Noonan for the necessary time wherein to prepare and file a written opinion on the bill recently passed by the Municipal Assembly reducing the price of gas from $1.25 to 90 cents per 1,000. Mr. Bond contends that the city has no right to regulate the price of gas, since the Laclede Company has filed with the city its acceptance of the conditions imposed by the St. Louis Gas Company's amended or substitute charter.

TOWARD the close of January a hearing was given at the Chelsea (Mass.) City Hall, by the Board of Gas and Electric Light Commissioners, on the petition of J. B. Everdean and others, that the Chelsea Gas Company be obliged to supply incandescent electric lights on the basis of a meter system. Mayor Champlin opened for the petitioners in the statement that it cost the objector something to stand in antagonism to the Chelsea Gas Company, as it always had a monopoly of the gas business in the city. This rather poorly defined sentiment was followed by another equally absurd remark that as the Chelsea Gas Company was controlled or owned by non-residents no care was had by it in respect to the interests of the community, who had to pay unreasonable rates for light. After other partisans of the Mayor had echoed the sentiments of their leader, the Gas Company's representative replied that it was ready and anxious to introduce the meter system as soon as it was demonstrated that a reliable electric current meter had been put upon the market. The Commissioners reserved their decision.

IN view of the cogency of the Chelsea Company's implied objection to the meters now in the market we fail to see how Mayor Champlin and his "echoers" are to be appeased; for finally the Board cannot be expected to solve a problem off-hand that has caused and will cause many a sleepless night to the inventive division of the electrical fraternity.

THE American Gas Engine Company has been chartered at Chicago, by Messrs. Chas. Fellows, C. W. Annable and H. C. Johnson. Capital, $200,000.

WRITING under date of Jan. 30, a correspondent says: "At the annual election of the Washington (O.) Gas Co. the following officers were elected: Pres., Morris Sharp; Sec. and Treas., Jerome Penn. Supt. Penns' annual reports show an increase over the half year, despite the competition of electric light, which displaced nearly half of the public lamps, and also took away quite a number of private consumers. The following are some of the percentages of increase: Gas used by private consumers, 18 per cent.; meters in service, 20 per cent.; gas stoves sold, 110 per cent.; gas engines in use, 100 per cent.; the company has leased a large room (18 ft. by 80 ft.) which will be used for an office and a workshop, from and after the first inst. The company expects to keep on hand a good supply of gas stoves and fixtures, and intends to make every possible effort to increase the use of gas for cooking and heating. The company's new dynamo was started last night. This gives it a capacity for 100 arcs, 51 of the latter being now in duty on the streets, and 25 are employed commercially. The company has a contract with the authorities for additional public lights, which will be placed this summer. The new bench of 5's put in last season worked satisfactorily, and another bench will be installed this summer.—J. P."

SECRETARY PENN has met with great success at Washington Court House, and his figures are vouchers that bear most eloquent testimony to the fact.

THE following Directors have been chosen by the proprietors of the Centralia (Ills.) Gas Company: Messrs. S. M. Warner, E. S. Condit, F. Kohl, G. L. Pittinger, Seymour Andrews and F. M. Tomkins.

BY the breaking of an oil gauge on the apparatus in the generating room of the Macon (Ga.) Gas Company, an explosion occurred that threatened disastrous consequences. The coolness and bravery of Supt. Wilcox alone prevented a tremendous explosion.

THE authorities of Lincoln, Nebraska, have again appointed a "City Gas Inspector." This time his name is E. J. Flaherty.

AT the annual meeting of the Pulaski Gas Light Company of Little Rock, Ark., the following officers were chosen: President, Maj. John D. Adams; Treasurer, Charles F. Penzel; Secretary, Dean Adams. The officers and Messrs. John G. Fletcher and J. H. McCarthy are the Directors.

THE Trustees of the Consolidated Gas and Electric Light Company, of Westchester County, New York, are Chas. B. Ludwig, H. S. James, A. B. Gilbeck, H. M. Henderson and Leonard G. Levy.

THE City Council of Fort Worth, Tex., has completed the plan under which the city is committed to the operation of a municipal electric lighting plant. The Edison United Company is to make the installation, and the contract calls for a plant equal to the maintenance of 308 incandescent lamps (from 25 to 32 candle power each) and 42 arcs, candle power of latter to be 2,000 nominal. The Edison Company is to receive $27,000, and the authorities estimate that "other expenses" will bring the total cost of the installation up to $40,000.

JUDGE PHELPS, of the Burlington, Iowa, District Court, has refused to grant an injunction prayed for by the Burlington Electric Light and Power Company in restraint of the Burlington Gas Light Company. Plaintiff contended that as the Gas Company was operating an electric light supply, without authority of a franchise for such operation, it should be ordered to cease such supply, and that the city should at once remove the Company's poles from the streets. In denying the injunction, Judge Phelps said that the Gas Company could operate its electric plant without special franchise, as long as the "fact of its operation advanced the public good."

THE plant of the Batavia (N. Y.) Gas Light Company has been sold to certain parties, who were represented in the preliminary negotiations by Mr. W. C. Jacobs. It is probable that Rochester (N. Y.) capitalists

are those now in control, and we think they have secured a good property.

AT the annual meeting of the Hoosick Falls (N. Y.) Gas Light Company the following officers were elected: President, Walter P. Warren; Vice-President and Secretary, C. A. Cheney; Treasurer, Willard P. Parsons; Directors, Walter A. Wood, Walter P. Warren, C. E. Dudley Tibbets, C. W. Tillinghast and C. A. Cheney.

A. R. TAYLOR, on behalf of Daniel Donoghue, of St. Louis, has brought suit, in the sum of $5,000, against the 1889 Board of Trustees of the St. Louis Gas Company. Complainant (who was an employee of the Company), on September 11, 1889, was injured by the caving in of the walls of a pipe trench, and this suit is to recover damages for injuries to person.

AT the annual meeting of the Youngstown (O.) Gas Company the following officers were chosen: President, George Tod; Secretary and Treasurer, P. T. Caldwell; Superintendent, Moses Coombs, Jr.; Directors, George Tod, C. H. Andrews, John C. Wick, W. J. Hitchcock and A. B. Cornell.

THE Mahoning Electric Light Company's proprietors also effected an organization identical with that of the Youngstown Gas Company.

AT the annual meeting of the San Francisco (Cal.) Gas Light Company Messrs. J. B. Crockett, Adam Grant, Levi Strauss, P. J. Donohue, D. J. Murphy, Ch. de Guigne and Geo. W. Prescott, were chosen Directors. In his annual report President Crockett reported that a greater quantity of water gas had been manufactured at the works in the last twelvemonth than in any previous year, though the manufacture of same was suspended during June, July and August, on account of a scarcity of oil supplies. The sales of gas were 37½ millions cubic feet greater than in 1888. The number of street lamps lighted was 5,355, an increase of 175. There had been a net gain of 1,653 consumers. Much attention had been given to main renewals and extensions. Secretary Barrett's report showed net assets amounting to $7,070,599. The cash in the treasury applicable to dividends is $370,020, which would seem to show that shares in the Company are a bargain at present quotations. During the year 12 monthly dividends of 30 cents each per share were paid, the disbursements on this account amounting to $360,000.

THE proprietors of the new Gas Company at Duquoin, Ills., have determined to sell gas at the following figures: For lighting, $1.50 per 1,000; for cooking and heating, $1.25 per 1,000.

AT the annual meeting of the Bristol (R. I.) Gas Light Company the following result was reached: President, Hon. R. S. Franklin; Sec., Treas. and Supt., J. Howard Manchester; Directors, Hon. R. S. Franklin, J. C. Swan, Col. Augustus P. Sherman, A. C. Church and J. H. Manchester.

ARGUMENT is now on in the Supreme Court of Pennsylvania, on the appeal of the Penn Gas Coal Company from a Common Pleas (Westmoreland county) decree refusing to grant a preliminary injunction against the Versailles Fuel Gas Company. The Penn Company is the owner of six tracts of land in Westmoreland county, with the right to remove all the underlying coal without liability for damage, and over the surface of this land the defendant proposes to lay its pipe lines, which will necessitate the leaving in place of about 50 acres of coal, of a value of at least $30,000. It is also alleged that the pipe is being laid in a way dangerous to life and property. Decision is expected in a few days.

THE net gas rate at Cambridge, Mass., is to rule at $1.60 per 1,000 from April 1st. This is a reduction of 15 cents.

THE Wallingford (Conn.) Gas Company is experimenting with a high power gas burner for street lighting purposes.

AT the annual meeting of the Malden and Melrose (Mass.) Gas Light Company the officers' reports were of the most encouraging nature. The increase in sendout over that for 1888 was much beyond the hopes of the shareholders. A quarterly dividend of 2 per cent. was declared, and the following officers were elected: President, Joshua T. Foster: Treasurer, Geo. D. Bill; Directors, J. T. Foster, Geo. D. Bill, A. M. Copp, D. V. Cox, J. H. Converse, L. P. True, E. S. Converse, D. W. Gooch, L. B. Hildreth and D. Russell.

MR. PETER ENGLISH, in connection with G. D. Lewis, visited Galesburg, Ills., with a view to "working up a healthy sentiment" for the establishment at the latter place of an opposition gas plant of the English process type. They believe that it will require $100,000 of nominal capital to start the Galesburg venture, of which 50 per cent. is to be paid up, and they would like residents of Galesburg to take half of the sum required. They "point with pride" to the success of the English plant at Aurora, Ills., where a 24-candle gas is said to be sold at $1.25 per 1,000. In reality, Aurora is far from satisfied with the English system of gas making and supply, and the complaints about poor service are frequent and loud. In the meantime Galesburg capitalists might do well to look over these facts prior to putting down their names in Mr. Lewis' subscription book. The city has a population of about 12,000, who are now consuming about 8 millions cubic feet of gas per annum, the rates for same being $1.50, $1.60 and $1.80 per 1,000. At these rates the Company manages to earn a dividend. Start another Company, capitalized in $100,000, then divide the profits arising out of the maximum sales noted, and where will shareholders in either concern receive a return? If Galesburg's capitalists are wise they will not only refuse to invest in this scheme, but will join together in keeping a franchise for an opposition company from all comers. Another company would put an end to Galesburg's opportunity in the future for cheap gas.

Influence of Temperature on Electric Tests.

The *Engineering Record* asserts that the question of temperature bears an important part in all tests of wire employed for electric transmission, since the resistance, both of metals and insulating materials, varies with the temperature.

Thus, we find it stated that the resistance of iron wire increases about 0.35 per cent. for each additional degree Fahrenheit, while the resistance of copper wire increases about 0.21 per cent. for each additional degree Fahrenheit. According to the Washburn & Moen Manufacturing Company, Dr. Mattheisen's report of the British Association Committee on Standards of Electrical Resistance states that hard iron varies between zero and 100° Centigrade (32° and 212° Fahrenheit) as much as 39.2 per cent., while German silver varies only 4.4 per cent. An alloy of silver with 31.4 per cent. of platinum varies only 3.1 per cent. For the best resistance coils some metal or alloy is used that is affected as little as possible by variations of heat.

It is necessary, for the sake of comparison, to fix a standard of temperature to which all tests shall be reduced. Cully gives this standard at 75°, a temperature high enough to exaggerate faults in insulation, yet not so high as to injure the material. Sprague says 60° F. is the most convenient for the adjustment of resistances. In this latitude, where for months a temperature so low as 60° is not reached, from 70° to 72° is found to be a more convenient scale, and it has been adopted by the Standards Department at Washington.

Luminous Paint.

Until recently the commercial manufacture of luminous paint has been confined to England, where a single factory turned out a small supply at a price of about $3 a pound. This enormous cost seems to have prevented the use of the paint except as a curiosity. During the past year, however, a firm in Austria has found means to produce it and place it on the market at 50 cents a pound, or about one-sixth of the English price. Even at 50 cents a pound, a substance composed of roasted oyster shells and sulphur might be manufactured at a good profit, but at that price it is likely to come into extensive use. Wherever it can absorb light during the day it will give it forth at night, and it is said that a railway car in England, which has had its ceiling painted with it, was so brilliantly illuminated that one could see to read a newspaper in it during the darkest night, without other light. With all due allowance for the enthusiasm of early experimenters, there is no doubt that cars with ceilings so painted would be pleasant to ride in whether one could really see to read in them at night or not; and for making keyholes, stairways and sign-boards luminous, the paint would be invaluable. Its application to stairways is a particularly obvious one, and the Austrian manufacturers furnish a kind of wall paper on which the paint can be used to better advantage than on the bare plastering. The paper, which is of a leathery texture, is first treated with lime water, and then primed with a composition, furnished by the same firm. After this is dry, two thin coats of the luminous paint are applied, and the whole may then be varnished.

THE AMERICAN GAS LIGHT JOURNAL

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MONDAY, FEBRUARY 10, 1890.

The Market for Gas Securities.

The market for city gas shares, in common with other stocks that suffered from the persistent hammering of those interested on the "short" side of the speculative turn. was inclined to dullness, although prices suffered very little. The truth is, that the quantity of Consolidated stock available for some time back for speculative purposes has been greatly curtailed in the last six months. The shares have found their resting place in the "strong boxes" of investors; hence, on a weak general market the effect is not exerted on quotations, but is shown in a cessation of stock offerings. On one day of the week only 5 shares were sold on Exchange. The bid figure to-day (Friday) is 96¼, as against 96½ a week ago. Brooklyn shares are strong, notably Nassau, which is at 115 bid, with no offerings. Baltimore Consolidated is again at the advanced price of a fortnight ago, 54½–55. Chicago Trusts are strong at 47¼ bid. Bay State common is in demand at from 23–24½. We omitted to note in its proper place that Standard, of New York city, is again being inquired after. The common is quoted at 42–46, while the preferred rate may be returned at 83–86. Laclede common is weaker at 16½–17¼.

In connection with the Baltimore gas supply, well informed people think that an arrangement will be perfected by the Maryland Legislature under which the Consolidated Company will, in consideration of certain concessions to the city, be granted an exclusive right for a term of years.

Gas Stocks.

Quotations by Geo. W. Close, Broker and Dealer in Gas Stocks,

16 WALL ST., NEW YORK CITY.

FEBRUARY 10.

☞ All communications will receive particular attention.

☞ The following quotations are based on the par value of $100 per share.

	Capital.	Par.	Bid	Asked
Consolidated	$35,430,000	100	96¼	—
Central	500,000	50	—	—
" Scrip	220,000	—	—	—
Equitable	4,000,000	100	120	125
" Bonds	1,000,000	—	113	115
Harlem, Bonds	170,000	—	—	—
Metropolitan, Bonds	658,000	—	116	118
Mutual	3,500,000	100	107½	—
" Bonds	1,500,000	—	100	102
Municipal, Bonds	750,000		—	—
Northern		50	—	—
" Bonds	150,000	—	—	100
Standard Gas Co—				
Common Stock	5,000,000	100	42	46
Preferred	5,000,000	100	83	86
Yonkers		50	112	—
Richmond Co., S. I.	346,000	50	—	—
" Bonds	20,000	—	—	—
Gas Co's of Brooklyn.				
Brooklyn	2,000,000	25	109	111
Citizens	1,200,000	20	68	70
" S. F. Bonds	320,000	1000	100	103
Fulton Municipal	3,000,000	100	122	—
" Bonds	300,000		100	105
Peoples	1,000,000	10	77	—
" Bonds (5's)	368,000	—	100	—
" " (6's)	94,000	—	100	—
Metropolitan	1,000,000	100	93	96
Nassau	1,000,000	25	115	—
" Ctfs	700,000	1000	100	112
Williamsburgh	1,000,000	50	119	122
" Bonds	1,000,000	—	108	112
Out of Town Gas Companies.				
Boston United Gas Co.—				
1st Series S.F. Trust	7,000,000	1000	—	92½
2d " " "	3,000,000	1000	71	72
Bay State Gas Co.—				
Stock	5,000,000	50	23	24½
Income Bonds	2,000,000	1000	—	—
Buffalo Mutual, N. Y.	750,000	100	90	95
" Bonds	200,000	1000	95	100
Citizens, Newark	1,000,000	50	155	160
" " Bonds	45,000	—	—	—
Chicago Gas Trust	25,000,000	100	47¼	—
Chicago Gas Light & Coke Co.—				
G't'd Gold Bonds	7,650,000	1000	93½	93¾
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1000	97	—
People's Gas and Coke Co., Chicago—				
1st Mortgage	2,100,000	1000	—	99
2d "	2,500,000	1000	—	97
Consumers Gas Light Co., Jersey City	2,000,000	100	15	25
Bonds	600,000	1000	80	—
Cincinnati G. & C. Co.	6,000,000	100	201	203
Consumers Toronto	1,000,000	50	190	200
Central, S. F., Cal.			80	90
Capital, Sacramento, Cal			58	
Consolidated, Balt.	11,000,000	100	54½	55
" Bonds	6,400,000		107	107½
Hartford, Conn.	750,000	25	102	108
Jersey City	750,000	20	186	190
Laclede Gas Light Co., St. Louis, Mo.—				
Common Stock	7,500,000	100	16½	17¼
Preferred "	2,500,000	100	—	—
Bonds	9,034,400	1000	—	86
Louisville, Ky.	2,570,000	50	125	130
Little Falls, N. Y.	50,000	100	—	100
" Bonds	25,000	—	100	103
Montreal, Canada	2,000,000	100	200	208
Memphis (Tenn.) Gas	750,000	100	48	51
" Bonds	240,000	100	103	—
New Haven, Conn.		25	200	—
Oakland, Cal.			35	35½
Peoples, Jersey City		—	60	61
" " Bonds			—	—
Paterson, N. J.		25	99	102
Rochester, N. Y.		50	99	100
Syracuse, N. Y.	500,000	25	—	—
San Francisco Gas Co.			60	60½
San Francisco, Cal.	10,000,000	100	59¾	60
Washington, D. C.	2,000,000	20	200	208
Wilmington, Del.		50	88	90

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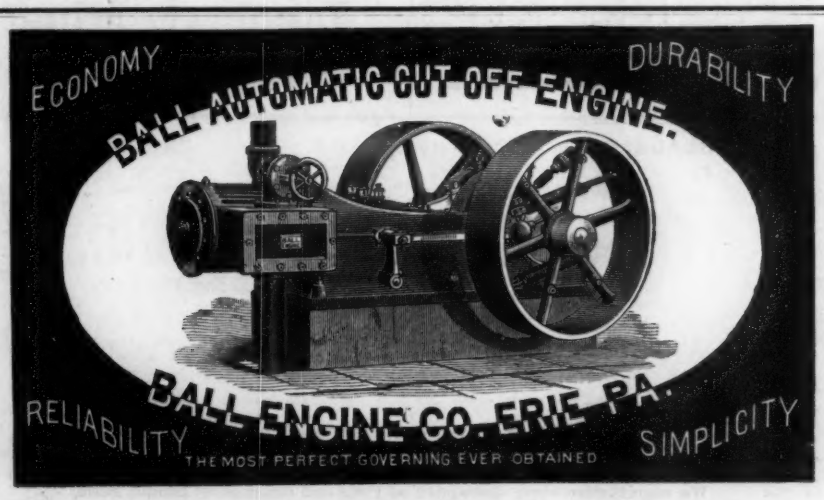


F. D. HARMON, Pres. CHAS. C. ALLEN, Sec. and Treas. P. W. MACKENZIE, Chief Engr. & Supt.

THE FUEL GAS AND LIGHT IMPROVEMENT CO.

OF AMERICA.

Owners of the RECENT Mackenzie Patents,

For the United States, England, Russia, France, Germany, Austria, and Canada,

No. 32 Park Place, New York City.

This SYSTEM is an ABSOLUTELY NEW DEPARTURE IN THE MANUFACTURE OF FUEL AND ILLUMINATING GAS.

The COST OF GAS IN THE HOLDER by our System is at least THIRTY PER CENT. LESS than that made by any other process of the day.

The Gas is manufactured WHOLLY from LIQUID HYDROCARBONS, such as Lima, Penn, Crude, and Fuel Oils, Naphtha, etc.

Neither PERISHABLE PIPES or other RETORTS, NOR THEIR EQUIVALENTS, are used.

Neither COAL, COKE, nor any other HARD CARBONS enter into the manufacture or composition of the Gas, thereby requiring LESS LABOR THAN ANY OTHER METHOD.

The Gas contains neither SULPHUR nor other impurities, nor is there any resultant LAMPBLACK OR TAR RESIDUUM.

The Gas requires NO PURIFICATION whatever.

The FUEL GAS COSTS VERY MUCH LESS than PURE UNCARBURETED WATER GAS, and contains DOUBLE THE HEAT UNITS.

The APPARATUS is extremely SIMPLE, SUBSTANTIAL, and DURABLE, and consists of a Single Body with a capacity of ONE THOUSAND to ONE HUNDRED THOUSAND cubic feet per hour.

Works may be constructed to run by the CONTINUOUS or ALTERNATING method. If run continuously, the limited amount of Nitrogen present is neutralized by Carbon.

The Gas can be made of a HIGH GRADE for illuminating purposes, of a MEDIUM QUALITY for distribution for domestic purposes, and of a LOW GRADE for manufacturing uses.

Wherever Liquid Hydrocarbons can be had the MACKENZIE PROCESS WILL COMPETE IN PRICE AND SUPPLY ALL THE ADVANTAGES incidental to the use of NATURAL GAS.

This Company desires contracts for the construction of Plants, parts of Plants, Apparatus, Buildings, Holders, and Street Mains, for either of the above purposes, and will Lease or Purchase Works upon satisfactory terms.

Information will be promptly given regarding material required for production of Gas, actual cost of product, cost of works, etc.

Bartlett Street Lamp Mfg. Co.

MANUFACTURERS OF

Globe Lamps,

FOR

Streets, Parks, Public Buildings, Railroad Stations, etc.

LAMP POSTS

A Specialty.

Office and Salesroom,

40 & 42 COLLEGE PLACE, - - N. Y. CITY.

Gas Companies and others intending to erect Lamps and Posts will do well to communicate with us.

The Miner Street Lamps.

Jacob G. Miner,

No. 823 Eagle Ave., New York, N. Y.

6 PER CENT.

First Mortgage Bonds

ON GAS WORKS

SITUATED IN GROWING WESTERN TOWNS.

Principal and Interest Guaranteed.

INTEREST SEMI-ANNUALLY.

For sale by the undersigned, who will furnish all necessary information regarding them.

JOS. R. THOMAS, 42 Pine St., N. Y. City.

No. 29 Champion.

PHILADELPHIA. NEW YORK. CHICAGO.

STEPHEN A. MORSE, President. EDWIN F. MORSE, Secretary.

GODFREY REBMANN, Vice-Pres. CARLTON M. WILLIAMS, Treas.

STANDARD GAS LAMP CO.,

Main Office, 411 Cherry St. Factory, 1101, 1103, 1105 Frankford Av.

PHILADELPHIA, PA.

It is to the interest of Gas Companies and Cities to double the efficiency of the light on streets by using Dyott's Patent "CHAMPION" LAMPS. They save 50 per cent. over others in cost of repairs, are ornamental, and indestructible except by violence.

Our Patent System of Instantaneously Lighting Gas (without electricity), for Railroad Depots is unequaled.

Dyott's High Candle Power Burner is a very superior lamp where a concentrated and brilliant light is wanted in Hotels, Stores, Depots, etc.

Special Drawings furnished and Estimates cheerfully given, either from Architects', Engineers', or our Draughtmen's Plans.

We manufacture every description of Plain and Ornamental Lamps, Posts, Brackets, Clusters, etc. Correspondence solicited,

Simpkin & Hillyer

RICHMOND, VA.

MANUFACTURERS OF

Gas Works Apparatus

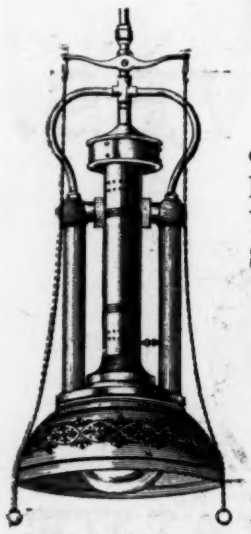
BENCH CASTINGS, CONDENSERS,

Scrubbers, Purifiers, Dry Center Seals,

FOUR-WAY VALVES, GAS VALVES,

SULPHATE OF AMMONIA APPARATUS,
TANKS, ENGINES, BOILERS,
PUMPS, ETC., ETC.

Plans, Specifications and Estimates furnished for new works, or alteration of old works. Correspondence solicited. Works, Newport News, Va.



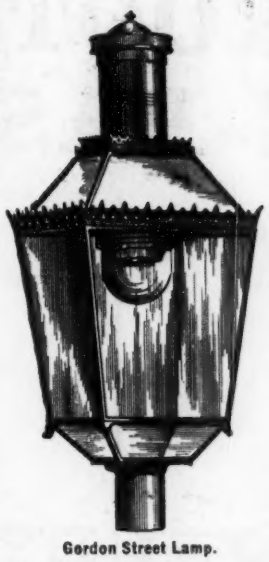
Gordon Portico Lamp.

The Gordon Portico Lamp.

A successful Competitor of the Arc Electric Light for lighting Store Fronts, Show Windows, Depots, Railway Sheds, etc., etc.

The Gordon Street Lamp.

A Successful Competitor of the Arc Electric Light for lighting Streets, etc., etc.



Gordon Street Lamp.

The Lungren Lamp.

A Successful Competitor of the Incandescent Electric Light for Interiors, etc. Is especially applicable for the lighting of Offices, Stores, Factories, Mills, Show Windows, Libraries, and all situations where an increased illumination is desired.

More than 25,000 Lungren Lamps are now in use. Testimonials, references, or any desired information will be cheerfully given.

Lungren Lamp.

THE SIEMENS-LUNGREN CO., N.E. Cor. 21st St. & Washington Av., PHILADELPHIA.

WELSBACH SYSTEM

OF

Incandescent Gas Lighting.

OFFICE, DREXEL BUILDING, PHILA., PA.

At the Fall Session of the Board of Supervisors of Winnebago County, held at the County Court House, Oshkosh, Wis., Nov. 26, 1889, the report submitted by Mr. C. W. Cook, Chairman of the Committee on Public Buildings, recommending the use of the Welsbach Incandescent Gas Burner in the Buildings under their charge, was unanimously adopted, because of the extreme economy in the consumption of Gas and the superior character of the light obtained.

JEWEL GAS STOVES

MANUFACTURED BY

GEORGE M. CLARK & COMPANY,

Nos. 157 & 159 Superior Street, - - - Chicago, Ill.

EVERY CONCEIVABLE SIZE AND STYLE,

Ranging in Prices from $1.50 to $30.00.

WE USE NO GAS COCKS.

All Flames are Regulated by a Direct Needle Valve.

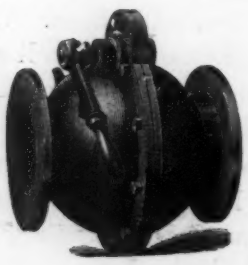
The JEWEL

IS THE

Only Well-Made Gas Stove on the Market.

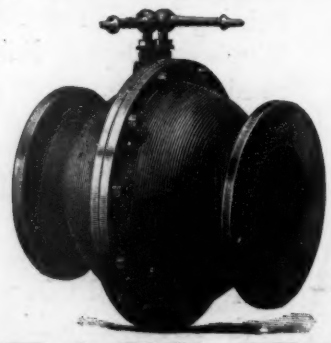
Write for our 1890 Catalogue and see for yourself.

ROOTS'
GAS AND BYE-PASS VALVES.



GAS VALVE

Quick Acting,
Simple,
Efficient, Durable.

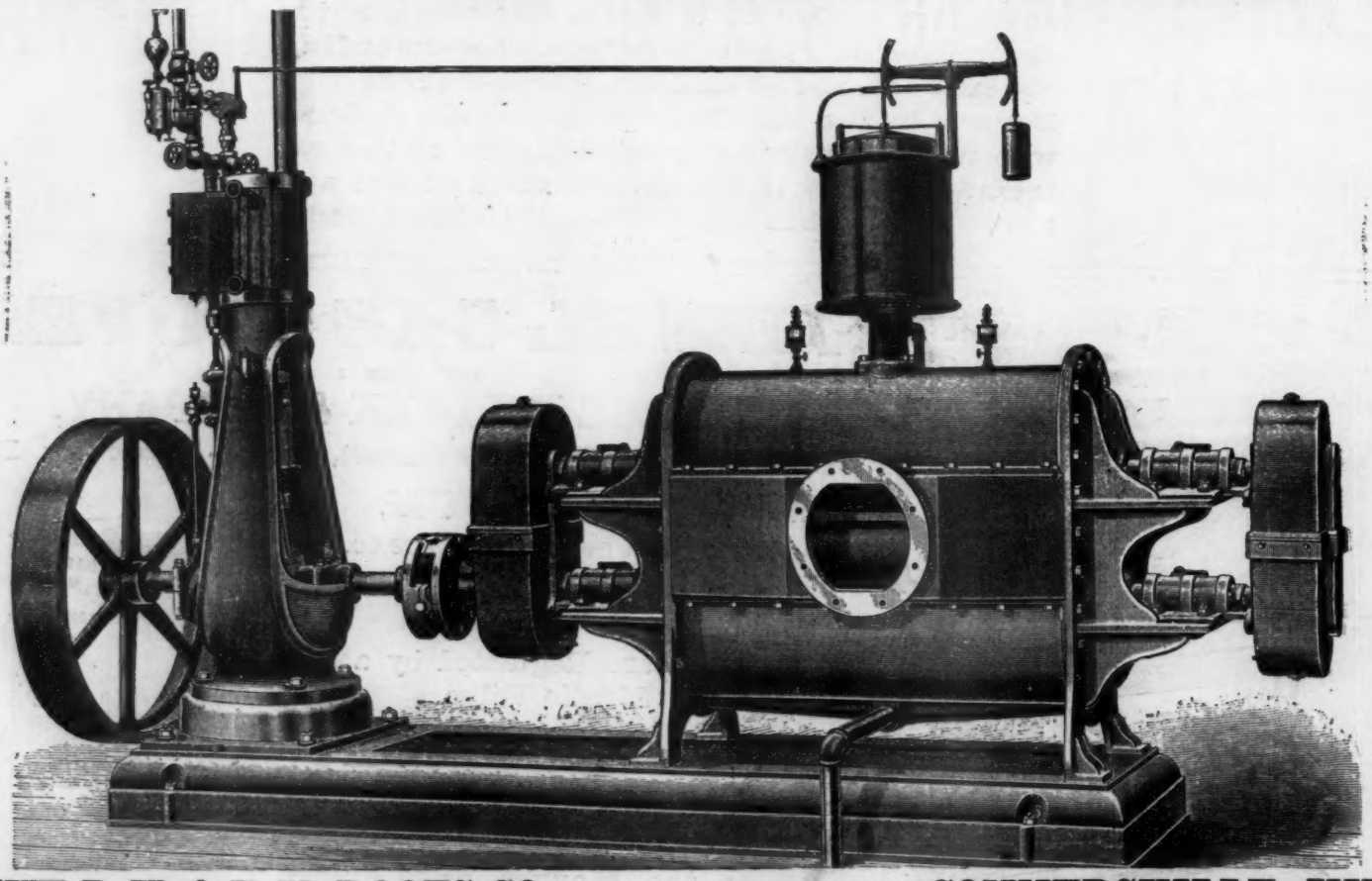


BYE-PASS VALVE.

Automatic Action,
Reliable,
Simple, Durable.

Thousands now in use and giving perfect satisfaction. Write for Catalogue and Prices.

ROOTS'
NEW GAS EXHAUSTER.

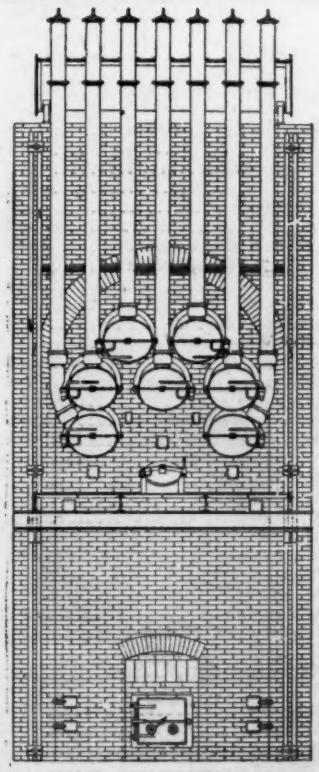


THE P. H. & F. M. ROOTS CO., Patentees and Manufacturers, **CONNERSVILLE, IND.**

S. S. TOWNSEND. Gen. Agt., 22 Cortlandt St., N. Y. COOKE & CO., Selling Agts., 22 Cortlandt St., N. Y.

THIS SPACE
WILL BE
Occupied Next Month by the
KERR MURRAY MFG. CO.
FORT WAYNE, IND.
GAS WORKS
APPARATUS
AND
HOLDERS.

LACLEDE FIRE BRICK MANUFACTURING COMPANY,

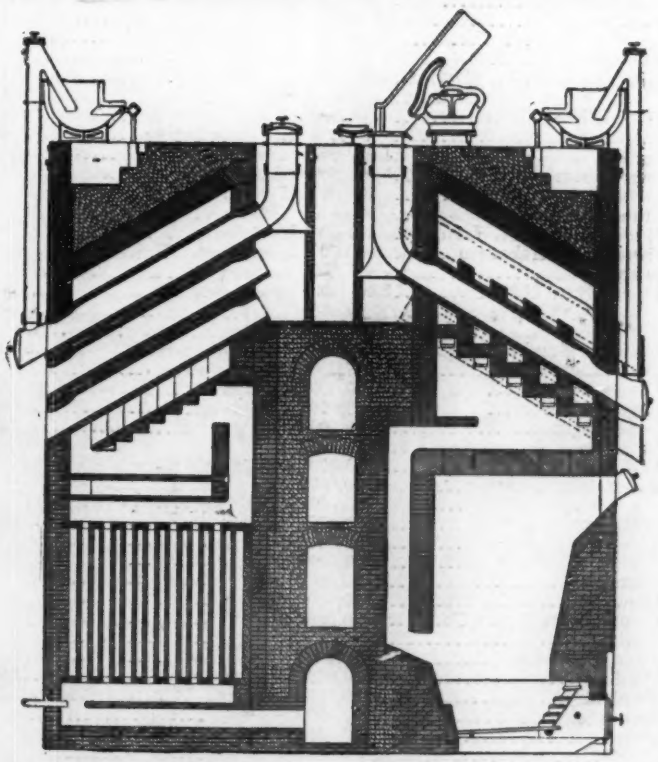


ST. LOUIS, MO.

Exclusive Agents in the United States
FOR THE
Coze System of
Inclined Retorts.

IT IS THE COMING BENCH
FOR MAKING COAL GAS.

It will Save from 50 to 60 per ct. in Labor.



ESTIMATES AND PLANS FURNISHED BY THE
LACLEDE FIRE BRICK MFG. CO., ST. LOUIS, MO.

KIRKHAM, HULETT & CHANDLER, LIMITED.

PATENT "STANDARD" WASHER-SCRUBBERS

Erected and in course of construction at present date:

	Capacity. Cubic feet per day.
Altrincham	600,000
Adelaide	600,000
Aldershot	200,000
Allegheny, U. S. A.	1,000,000
Ashton-under-Lyne	1,250,000
Amsterdam	1,500,000
"	1,500,000
Annaberg	200,000
Arcachon	100,000
Animal Charcoal Co	200,000
Altoona, U.S.A.	350,000
Buxton	250,000
Bradford	1,000,000
"	1,250,000
"	1,250,000
"	1,250,000
"	1,000,000
"	1,000,000
"	3,000,000
Bremen	150,000
Baltimore, U.S.A.	1,000,000
"	1,000,000
"	1,000,000
Balmain, N.S.W	125,000
Bishops Stortford	150,000
Blackpool	400,000
Brussels	1,250,000
"	1,250,000
"	750,000
"	1,250,000
Banbury	250,000
Birmingham	5,000,000
Birkenhead	2,500,000
Blackburn	1,500,000
Bochum	600,000
Burntisland	250,000
Boston, U.S.A.	2,000,000
Brisbane	1,500,000
"	300,000
Burton-on-Trent	1,500,000
Barcelona	350,000
Barking	100,000
Baerlien & Co	20,000
"	20,000
Bombay	400,000
Buffalo, U.S.A., Mutual	750,000
" **Citizen**	500,000
Brookline, U.S.A	500,000
Bergen	350,000
Berlin	1,250,000
Bournemouth	1,000,000
Bridgeport, U.S.A.	500,000
Brunswick	300,000
Beck & Co., St. Louis	100,000
Barmen Rittershausen	600,000
Bexhill	125,000
Brooklyn, U.S.A	1,000,000
"	1,000,000
" **Nassau**	1,000,000
Brunner, Mond & Co.	400,000
Cheltenham	2,000,000
Cannes	200,000
Croydon	1,500,000
Copenhagen	200,000
Clevedon	200,000
Columbus, U.S.A	500,000
Cincinnati, "	1,500,000
" "	1,500,000
Chicago "	3,000,000
" "	1,000,000
" "	1,000,000
Chemnitz	1,000,000
Crewe	1,250,000
Colonial Gas Works Co	100,000
Cadiz	300,000
Charlottenburg	600,000
Dudley	750,000
Driffield	100,000
Dukenfield	500,000
Dover	750,000
"	1,000,000
Deal	200,000
Derby	1,500,000

	Capacity. Cubic feet per day.
Dublin	3,000,000
Dowlais	100,000
Douai	500,000
Denton	500,000
Derby, U.S.A	350,000
Denver, "	500,000
" "	1,000,000
Dusseldorf	750,000
"	500,000
Dumfries	250,000
Dunedin, N.Z	400,000
Darlington	1,250,000
Detroit, U.S.A	750,000
Edinburgh	1,500,000
"	2,000,000
Enfield	300,000
Essen	300,000
Elbing	150,000
Falmouth	150,000
Frankfort	300,000
Farnworth	400,000
Fenton	400,000
Friedenshutte	500,000
Furth	400,000
Freiburg	200,000
Goole	250,000
Glossop	300,000
Guildford	300,000
Gloucester	1,250,000
Gera	300,000
Grafton, N.S.W	100,000
Grieg	300,000
Georgetown, U.S.A	250,000
Gluckauf	200,000
Heywood	600,000
Holywood	125,000
Huy	70,000
Harrow	250,000
Harrogate	250,000
Halstead	150,000
Heilbronn	200,000
Havana, Cuba	750,000
Hastings	1,500,000
Huddersfield	300,000
"	750,000
"	1,500,000
Hof	200,000
Hampton Wick	500,000
Heckmondwicke	500,000
Haverfordwest	100,000
Halifax, N.S.	350,000
Hamm	200,000
Halle	400,000
Heidelberg	300,000
Hartford, U.S.A	1,000,000
Ilkeston	300,000
Inverness	250,000
Ilkley	200,000
Ilford	100,000
Kingston-on-Hull	400,000
Kidderminster	750,000
Kidsgrove	100,000
Konigberg	1,000,000
King's Lynn	300,000

LONDON:—

The Gaslight and Coke Co.:	
Beckton	1,250,000
"	1,250,000
"	1,250,000
"	1,250,000
"	1,250,000
"	1,250,000
"	2,500,000
"	2,500,000
Silvertown	1,000,000
Bromley	2,000,000
"	1,500,000
"	1,500,000
"	1,500,000
"	2,000,000
"	1,500,000

LONDON—*Continued.*	Capacity. Cubic feet per day.
Shoreditch	2,500,000
Pancras	1,500,000
"	1,500,000
Pimlico	2,000,000
Nine Elms	3,000,000
"	3,000,000
South Metropolitan Co:—	
Greenwich	3,000,000
Woolwich	400,000
Vauxhall	3,000,000
"	3,000,000
Lea Bridge	300,000
West Ham	1,500,000
Leeds	2,000,000
"	3,000,000
"	3,000,000
"	3,000,000
"	3,000,000
"	2,000,000
Leominster	150,000
Leiden	560,000
"	600,000
Liverpool	2,000,000
"	2,000,000
"	2,000,000
"	2,000,000
"	2,000,000
"	3,000,000
Lincoln	1,000,000
"	600,000
Lowell, U. S. A	1,000,000
Louisville "	1,500,000
Long Eaton	500,000
Lilie	900,000
"	450,000
"	750,000
"	250,000
"	250,000
Luckenwalde	330,000
Liegwitz	300,000
Lincoln, U. S. A	250,000
Lawrence "	500,000
Lynn "	300,000
Lyons	1,500,000
Maidstone	1,000,000
Marseilles	1,500,000
"	1,500,000
Mons	500,000
Malines	250,000
Melbourne	1,500,000
"	1,500,000
"	1,500,000
"	1,500,000
"	1,500,000
Manchester	2,500,000
Middleton	400,000
Manley, N. S. W.	100,000
Minneapolis, U. S. A.	750,000
Magdeburg	300,000
Memphis, U. S. A	750,000
Nottingham	1,250,000
"	2,500,000
"	2,500,000
"	2,000,000
"	1,500,000
"	2,000,000
Newport, U.S.A	430,000
Newmarket	150,000
Newark, U.S.A	680,000
Northfleet	200,000
New York, U.S.A	2,000,000
Nice	600,000
Newcastle, N. S. W.	200,000
Numea, "	100,000
Namur	250,000
Newark	350,000
Oldbury	500,000
Otley	200,000
Oswestry	250,000

	Capacity. Cubic feet per day.
Ober Schlesian	1,500,000
Otto & Co.'s Coke Works	1,500,000
Plymouth	2,000,000
Parramatta, N. S. W.	100,000
Prescott	150,000
Providence, U.S.A	750,000
"	750,000
Plauen	300,000
"	300,000
Portsmouth	2,500,000
"	2,500,000
Pittsburgh, U.S.A.	1,500,000
Portland, "	560,000
Pawtucket, "	500,000
Quebec	250,000
Radcliffe	750,000
Rouen	250,000
Ramsgate	1,000,000
Reigate	200,000
Richmond, U.S.A	250,000
Roxbury, "	500,000
Runcorn Soap Co.	20,000
Rockhampton, N. S. W.	125,000
Richmond	1,500,000
Reading	2,000,000
Reichenbach	200,000
Salford	1,750,000
"	1,750,000
"	1,750,000
Smethwick	750,000
Sydney, N. S. W.	1,000,000
"	1,000,000
"	2,500,000
"	50,000
"	50,000
Sunderland	1,500,000
St. Josephs, U.S.A	250,000
Spa	100,000
Sevenoaks	300,000
St. Petersburg	2,000,000
"	1,500,000
St. Louis, U.S.A	2,000,000
"	2,000,000
"	1,000,000
Laclede	1,000,000
Silesian Coal Co.	600,000
San Francisco, U.S.A	2,000,000
"	2,000,000
Sheepbridge Coal Co.	40,000
Stettin	200,000
Singapore	300,000
Sutton	500,000
Tonbridge	150,000
Tipton	400,000
Tottenham	1,000,000
Toledo, U.S.A	750,000
Toronto	1,000,000
Uxbridge	300,000
Valparaiso	500,000
West Bromwich	1,000,000
Willenhall	250,000
Weston-super-Mare	500,000
Waltham	150,000
Wormwood Scrubs	300,000
Williamsburg, U.S.A	600,000
"	600,000
Wellington	150,000
Warwick	300,000
Wheeling, U.S.A	500,000
Walker	300,000
Westgate	100,000
Wilmington, U.S.A	500,000
Windsor, N. S. W.	100,000
Wolverton	100,000
Wellington, N. Z.	250,000
Whitchurch	175,000
Washington, U.S.A	2,000,000
Wallasey	750,000
Weimar	150,000
Wurzen	200,000
Worcester, U.S.A	750,000
Yeadon	500,000
Yeovil	250,000

SOLE AGENT FOR WESTERN HEMISPHERE,

GEO. SHEPARD PAGE, 69 WALL STREET, NEW YORK.

THE UNITED

GAS IMPROVEMENT CO.

DREXEL BUILDING, PHILADELPHIA.

OFFICERS:

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GEORGE PHILLER, Vice-President.
SAM'L T. BODINE, Gen'l Manager.
RANDAL MORGAN, Gen'l Counsel.
EDWARD C. LEE, Sec'y and Treas.
ALEX. C. HUMPHREYS, Gen'l Supt.
WALTON CLARK, Ass't Gen'l Supt.
H. H. EDGERTON, Chem. and Eng'r.

DIRECTORS:

GEORGE PHILLER, THOMAS DOLAN, HENRY C. GIBSON, WM. T. CARTER, WILLIAM G. WARDEN, SAM'L T. BODINE.

BUILDERS, LESSEES AND PURCHASERS OF

GAS WORKS.

Orders solicited from Large Cities, Small Towns, Mills, Institutions, from all who want more Light for Less Money.

NATIONAL GAS LIGHT AND FUEL COMPANY,

No. 218 La Salle Street, Chicago.

THE SPRINGER SYSTEM

OF

Fuel and Illuminating Water Gas Works.

REFERENCES.

People's Gas Lt. & Coke Co.	Chicago, Ill.
Illinois Light, Heat & Power Co.	Chicago, Ill
Elgin National Watch Co.	Elgin, Ill.
C. R. I. & P. R. R. Shops.	Chicago, Ill.
Decatur Gas Lt & Coke Co.	Decatur, Ill.
Niles Gas Light Co.	Niles, Mich.
Newton Illuminating Co.	Newton, Kansas.
Wellington Light & Heat Co.	Wellington, Kansas.
Chippewa Falls Gas Lt. Co.	Chippewa Falls, Wis.
Elkhart Gas Lt & Coke Co.	Elkhart, Ind.
Madison City Gas Light Co.	Madison, Wis.
South Bend Gas Light Co.	South Bend, Ind.
Sheboygan National Gas Co.	Sheboygan, Wis.
Salina Gas Light Co.	Salina, Kansas.
The Rathbun Co	Deseronto, Prov. Ont.
Jefferson City Gas Lt. Co	Jefferson City, Mo.
Mankato Gas Light Co.	Mankato, Minn.
Lima Gas Light Co.	Lima, Ohio.
Minneapolis Gas Light and Coke Co.	Minneapolis, Minn.
Bellevue Water and Fuel Gas Light Co.	Bellevue, Campbell County, Ky.
Bucyrus Gas Lt. & Fuel Co.	Bucyrus, Ohio.
Morris Gas Co.	Morris, Ill.
Los Angeles Gas Co.	Los Angeles, Cal.
San Diego Gas Fuel & Electric Lt. Co	San Diego, Cal.
Sioux Falls Gas Co.	Sioux Falls, Dak.
Dakota Gas and Fuel Co.	Grand Forks, Dak.
St. Johns Mutual Gas Co.	St. Johns, Mich.
Stillwater Gas Light Co.	Stillwater, Minn.
St. Paul Gas Light Co	St. Paul, Minn.
Emporia Electric and Gas Light Co.	Emporia, Kas.
Van Wert Gas Light Co.	Van Wert, Ohio.
Lansing Gas Light Co.	Lansing, Mich.
San Francisco Gas Lt. Co.	San Francisco, Cal.
Shelbyville Gas Light Co.	Shelbyville, Ind.
Great Falls Gas Light Co.	Great Falls, N. H.
Belleville Gas Co.	Belleville, Ontario
Rochester Lt. and Fuel Co.	Rochester, Minn.
Northwestern Gas Light and Coke Co.	Evanston, Ill.
Lincoln Gas Light Co.	Lincoln, Neb.
Davenport Gas Light Co	Davenport, Iowa.
Municipal Gas Co.	Albany, N. Y.
Alliance Gas Light Co.	Alliance, Ohio.
New Gas Light Co.	Janesville, Wis.
Chicago Gas Lt. & Coke Co.,	Chicago, Ill.
Joliet Gas Co.	Joliet, Ills.
Superior Light & Fuel Co.	Superior, Wis.
Kewanee Gas Light Co.	Kewanee, Ill.
Aberdeen Light & Fuel Co.	Aberdeen, So. Dak.
Pierre Light and Fuel Co.	Pierre, So. Dak.
*Standard Gas Light Co.	New York City.
*Carlinville Gas Light Co.	Carlinville, Ill.

* Building.

GUARANTEED ESTIMATES of Cost of Gas Furnished on Application.

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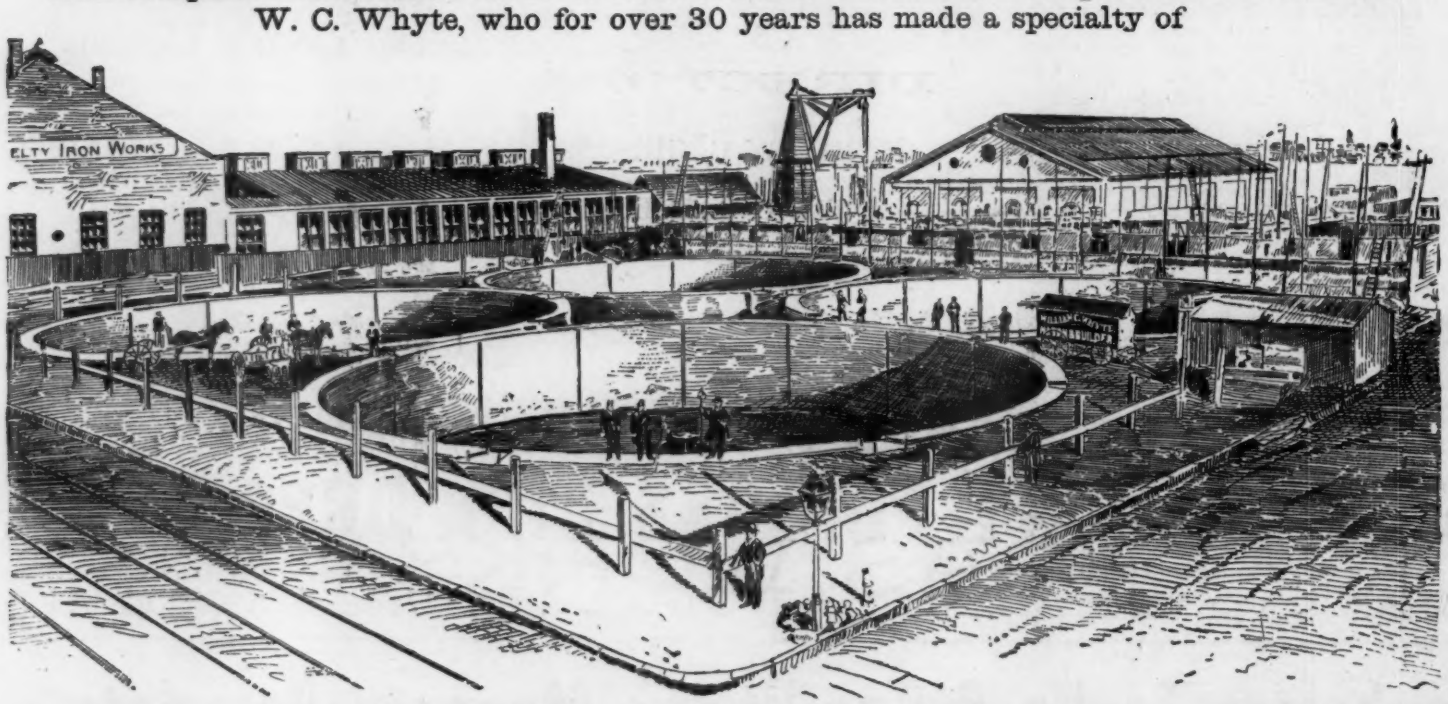

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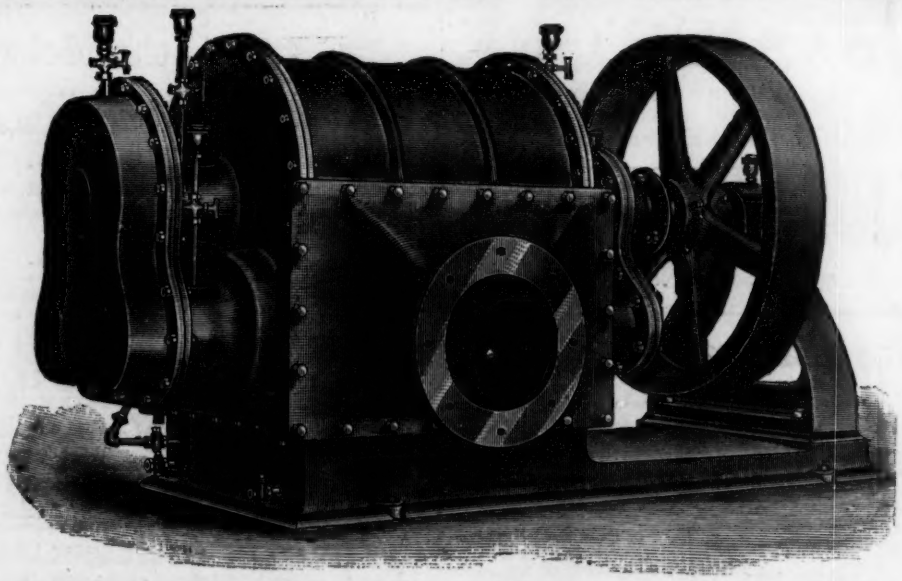

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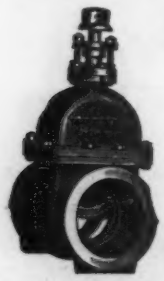

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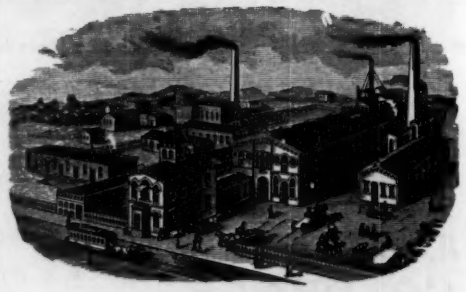

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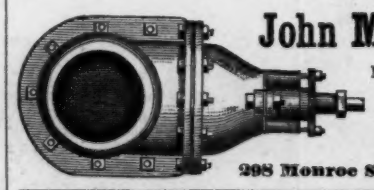

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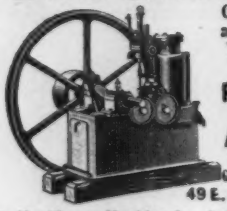

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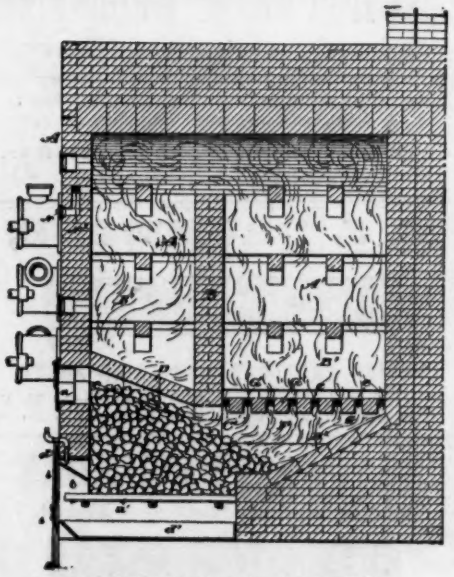

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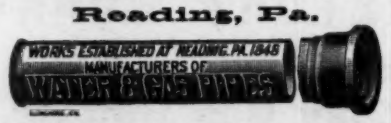

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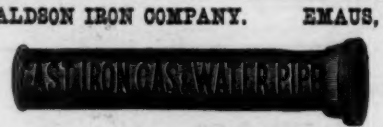

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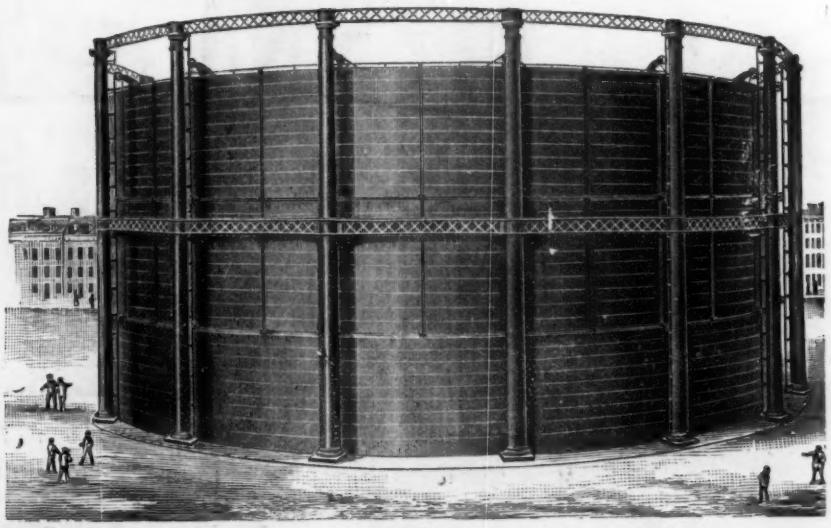

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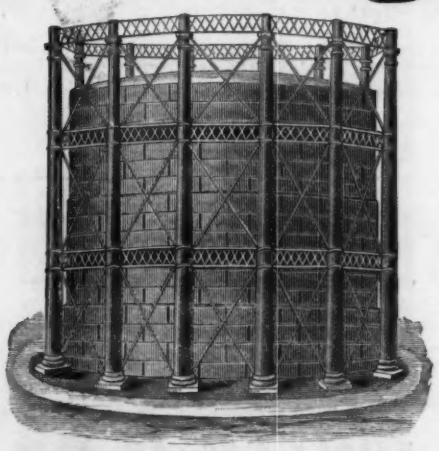

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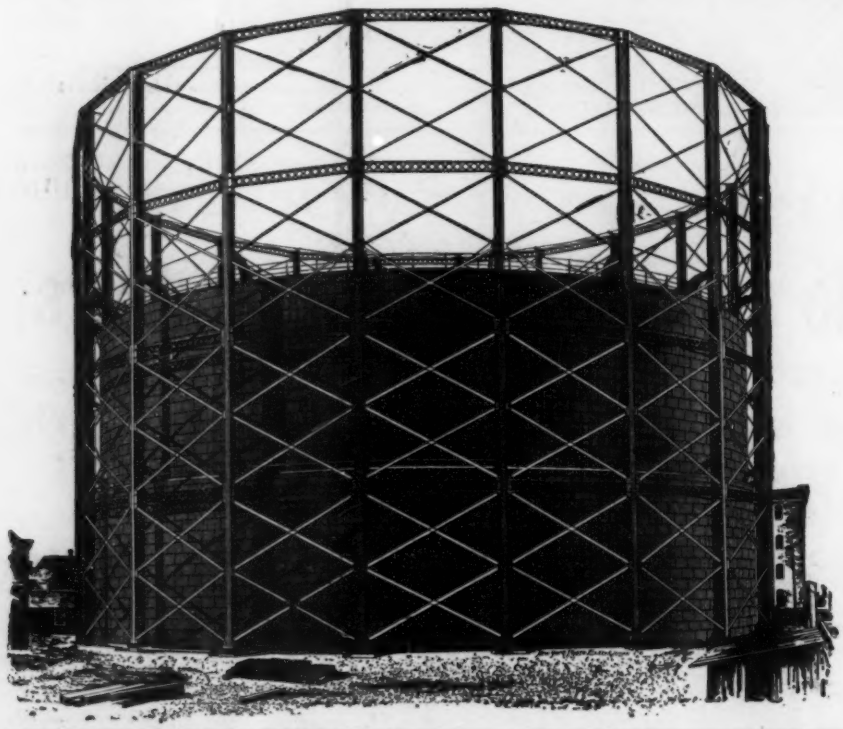

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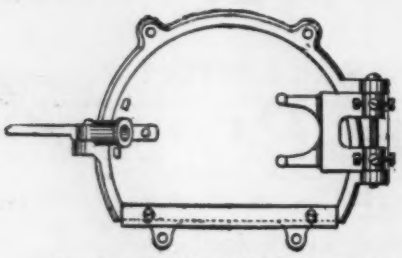

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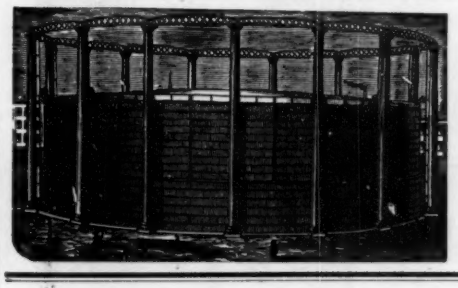

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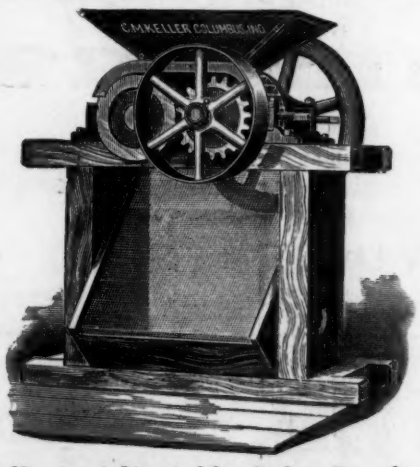

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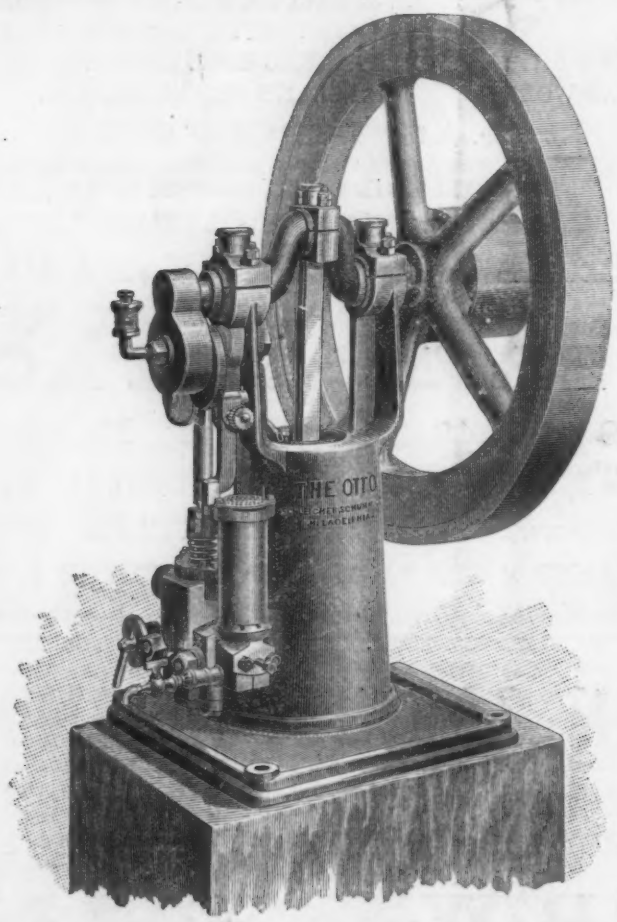

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